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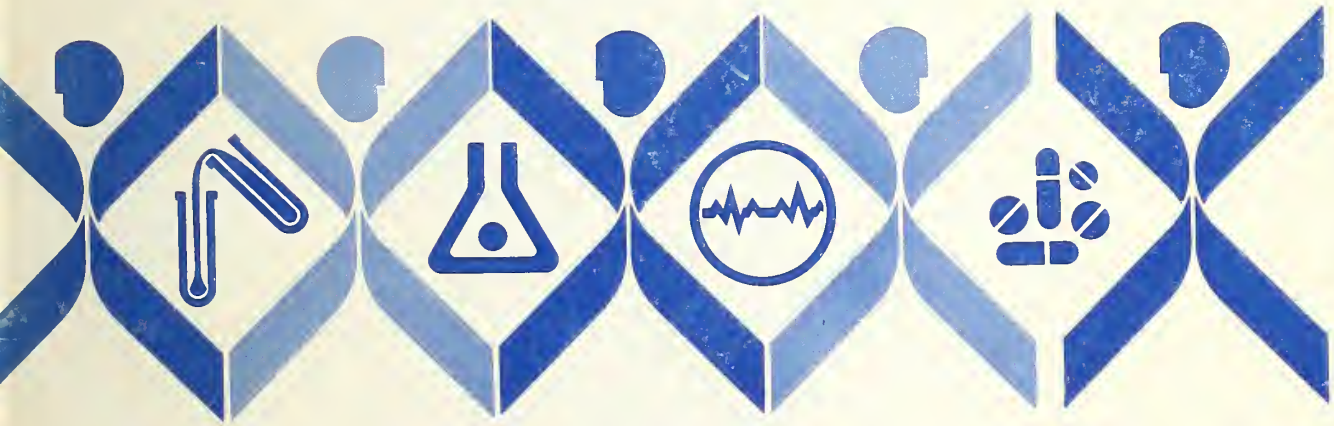

Report of the Panel on Biological and Medical Science of the President's Science Advisory Committee

Executive Office
of the President

Office of Science
and Technology

Scientific and Educational Basis for Improving Health

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THE WHITE HOUSE

WASHINGTON

Decisions will be made in the months ahead which will profoundly influence the future of medical care in our country. After intensive study and analysis, this Administration has developed a National Health Strategy to guide these decisions, a strategy which I submitted to the Congress and to the Nation in February of 1971.

One of the sources we drew upon in preparing that strategy was the report of the President's Science Advisory Committee which is now being made available to the public. Between September 1969 and August 1970, this Committee examined several aspects of the health care problem and prepared an initial draft of its conclusions. I met with the members of the Committee in September of 1970 and discussed their findings with them at some length. Their useful and constructive ideas and recommendations were fully considered as the Administration's program was developed. That program is a stronger one because of their efforts.

The insights which are presented in this report, like the knowledgeable contributions of others within and outside the Federal Government, provided a wide range of options for our consideration in constructing a comprehensive program. I believe the program which emerged from these consultations is one that is boldly innovative and carefully balanced. It is built on four basic principles: (1) helping all citizens to achieve equal access to our health care system; (2) assuring an adequate supply of medical care to meet increasing demand; (3) organizing a delivery system which is efficient and effective, one which emphasizes preventive services (including biomedical research) and one which is always conscious of costs; and (4) building on the strength which now lies in the diversity of American health care.

I am pleased to make this report available so that the work of the President's Science Advisory Committee can become a part of the public discussion as the Congress examines this critically important subject.

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Introduction

Health is a major concern of mankind. The tragedies of disease, disability, and premature death afflict individuals; they also limit attainment of national goals because of loss of productivity and because of the direct and indirect costs of health care. After manufacturing and agriculture, health care is the third largest industry in the United States and is growing rapidly. The direct cost of disease, approximately $60 billion per year, represents only the most visible part of the overall expense. The indirect costs of disease and premature death, namely the economic consequences of lost productivity, are enormous although largely unmeasured. Witness the chronic disability caused by rheumatoid arthritis or schizophrenia in 2.5 percent and 2.0 percent of the American population respectively. More than half a million Americans die of heart attacks annually and many of these deaths occur during the individual's most active and productive years. Economic estimates cannot include the serious psychological costs of illness to the individual and to his family.

The existing health care delivery system has failed to furnish adequate medical care equitably to all segments of American society. This failure is reflected partially in statistical health indices (infant mortality, life expectancy) which fall significantly below those of many less technologically advanced societies and is exacerbated by the rising costs of health care which threaten the very integrity of the health care system and the access of the American people to it. These shortcomings have become even more evident during the years of federal financing through Medicare and Medicaid. The initiation of these programs to pay for broadened health care of the elderly and disadvantaged altered the economics of the health care delivery system and increased the demand for care and the need for trained health manpower. The programs made health care more available to many citizens at a time of rapidly increasing costs, but they also exposed serious basic inadequacies in the health care delivery system.

The magnitude of our growing national commitment to general access to optimal health care for all Americans, when coupled with the extent of the disease problems still confronting us, poses an increasing challenge to the country in the years ahead. To meet this challenge, and to contain the costs within manageable limits, requires the development of definitive measures for the prevention and treatment of human illness.

Development of these measures depends greatly on advances in our understanding of human biology attainable only by biomedical research. Just after World War II, and even before its major involvement in payment for health care, the Federal Government assumed a responsibility to stimulate biomedical research in an effort to alleviate the health problems of this country. The resulting programs greatly expanded the role of the Federal Government in the health arena and moved the country into undisputed leadership in the biomedical sciences. The rapid increase in funds for research and research training in the middle 1950's led to an inextricable interweaving of research and educational activities in the medical schools and revolutionized the scientific basis of medicine. The capability and standards of health care in most areas improved and, more importantly, the foundation was established for the future conquest of the remaining unsolved major diseases, the continued existence of which represents a fundamental problem in health care.

American biomedical research directed toward the elucidation of disease processes has been highly successful, but during the past four or five

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years of budgetary restraint a critical re-examination of this effort has been initiated.

This report is concerned primarily with some issues which require immediate decisions by the Federal Government. Initially, the panel intended to devote its attention primarily to biomedical research, but it soon became obvious that the problems of health care delivery and medical education could not be separated from research. What evolved constitutes an examination of fundamental concepts and attitudes to serve as the basis for more detailed examination of several important individual problems. However, even though this report is intended to be an introduction to a series of intensive analytical scrutinies, the panel did nevertheless develop a number of explicit recommendations regarding (a) biomedical research, research training, and research in the health care system, (b) delivery of health services, and (c) national health policy.

Conclusions and Recommendations

BIOMEDICAL RESEARCH AND TRAINING

Conclusions

- It is primarily biomedical research that creates such medical care as there is to be delivered and hence shapes the delivery system.
- The record of recent decades shows clearly that each time a major disease has come under control, either through prevention or cure, the solution has been much simpler and far less costly than the technologies devised for the management of that disease during earlier stages of incomplete knowledge. Examples of obsolete "halfway technologies" include the older system for the care of victims of poliomyelitis, with iron lungs and intensive nursing care, and the hospitalization of large numbers of patients with tuberculosis. Immunization has greatly reduced both suffering and the cost of care for poliomyelitis; chemotherapy for tuberculosis has liberated extensive hospital facilities and medical personnel that are needed elsewhere. Moreover, each advance that has provided a cure or control to replace half-way technologies, even when the advance superficially appeared to be the result of an empirical or accidental finding, has depended for methodology, direction, or fundamental insight on prior basic research.
- The list of major human diseases for which we lack definitive measures for prevention or cure is still formidable. It is in the management of these diseases that the present deficiencies of our health care system are most visible and frustrating, not primarily because of shortages of professional manpower or hospital facilities but because so little is available in the way of truly effective technology. This lack of effective methods for dealing with these diseases poses the greatest problem for any future health care system.
- The tenor of the times has brought into question, or at least under reassessment, the emphasis formerly accorded the biomedical research enterprise within the federal budget. We perceive the objectivity of the reassessment to be severely compromised by the economic and political realities of apparent competition between research and medical care for limited funds. If it exists, this competition must be reduced or eliminated, since medical care and biomedical research are inseparable features of a single objective—better health for all.
- The problems of health care delivery are urgent, and require their own solutions, but a reduction in the biomedical research and research training effort would be a mortgaged solution with unacceptable consequences, namely, reductions in the rate of medical progress, in the quality of medical education, and ultimately in the health of the American people.
- The support of biomedical research should be consistent. Erratic changes in the level of financial support of a scientific enterprise destroy morale, vitiate planning, and waste human and capital resources.
- Innovation in health care for the next generation depends on today's basic research. Such research takes place chiefly in universities, colleges, and their related medical centers. These centers are under pressure to expand their responsibilities by increasing the size of medical

school classes, by increasing the output of paramedical personnel, and by assuming a larger and more central role in the health care enterprise itself. These forces, coupled with the need for continuing and expanded research, place a severe financial strain on the medical centers.

- If the science and technology of medicine were static and unchanging and if we were to expect no new advances in the understanding and therapy of human disease, new physicians could be trained by the book and by rote, as technicians, to learn today's methods for the management of disease as matters of doctrine. But if the scientific understanding of disease processes is to be continually enhanced and changed, and new forms of treatment are to be based on this new information, then there can be no question about the "relevance" of basic biological science to the education of physicians.

We Recommend

1. That an objective of highest priority for federal health care programs be the elimination or mitigation of the major human diseases for which effective technologies for prevention, cure, or control do not now exist.

2. That biomedical research be recognized as a central element in federal health programs and that stable levels of fiscal support be provided for it.

The annual amount of support should be extrapolated from existing levels and projected for three years. In the absence of significant new initiatives, the rate of change in this indicative budget for biomedical research, either up or down, should be gradual and considered in relation to its impact on universities and colleges.

The biomedical research support mechanisms of NIH, NIMH, NSF, AEC, and DOD which include project grants, program project grants, and contracts have demonstrated their effectiveness and should be continued.

3. That a stable base be established for support of research training programs and fellowships at both predoctoral and post-doctoral levels, adequate to assure an uninterrupted flow of research and teaching manpower for both basic and clinical science. The level of support should be established on the basis of the most precise estimates possible of the present and future needs for both Ph. D. and M.D. scientists for research and teaching in colleges, universities, research institutes, government agencies, and industry. The activities supported by training grants involve a large amount of patient care, and further reduction of support will have effects on American medicine far beyond limiting the output of research scientists. Therefore, federal support for research training programs and fellowships should be maintained at least at the FY 1969 level with adjustments for inflation, until a thorough analytic study can be made of the direct and indirect, immediate and long term, consequences of alteration of the present levels and mechanisms of support for research training programs and fellowships. If such an analysis results in a decision to reduce the number of graduate students and post-doctoral fellows, such a reduction should be coupled with the creation of alternate mechanisms of specific support for trainees, faculty, and for highly specialized diagnostic and therapeutic services to the extent that the study shows they are necessary.

4. That the importance of basic biomedical research in mission-oriented federal agencies, such as HEW, VA, AEC, DOD, and NASA, continue to be recognized and emphasized and that the agencies be given a clear and continuing mandate to engage in and support such research.

5. That when an area of undifferentiated research has progressed to the point that it appears possible to focus the work, support for the "targeted" phase of the research program by expansion of contract programs of NIH or NIMH should be derived from appropriation of new funds rather than from a trade-off against ongoing programs of basic project research or research training.

6. That a mechanism be developed to enable academic medical centers to receive funds for payment of faculty, whether for research or for education, as a single institutional grant based on an appropriate formula reflecting the size of federally supported programs within the institution and hence the institution's response to federal initiatives and missions. The substitution of this type of arrangement for the present system of adding the salaries of investigators to each grant, project by project, would go far toward maintaining stability despite the unanticipated program changes generated by the variable and unpredictable bud-

getary restrictions such as those of the past four years.

7. That support of research into the causes, prevention, and control of mental illness be expanded and in particular that programs of support for research into growing problems of a "medical-social" character (such as addiction and alcoholism) be developed and funded in accordance with their increasing importance in our society.

8. That large-scale projects for research and innovation in the delivery of health care be undertaken with federal funding, and that such projects be designed to permit critical comparison and evaluation of alternative systems with regard to effectiveness, efficiency, and public and professional acceptability.

9. That the National Center for Health Services Research and Development, working with appropriate organizations, in and out of Government, survey present criteria for measuring the quality of health care delivered by individual physicians, and conduct and support studies for the development of additional criteria to be applied more generally to medical practice, and that the National Center for Health Statistics extend its efforts in the development of health indicators. These activities should be accorded highest priority in the two agencies and resources to support them should be allocated accordingly.

DELIVERY OF HEALTH SERVICES

Conclusions

- To reduce the ever-widening gap between health needs and the ability of our health care system to meet them requires reorganization of the health care system, changes in methods of payment, and modification of medical education. Health care will only be improved significantly by a large increase in the number of physicians graduating from our schools if the health care system is restructured.
- Improvements in health care are unlikely to evolve unless large-scale experiments and demonstrations in health care are undertaken. The cardinal requirement for an improved health care system in the United States is that it should be regionalized.
- One reorganization plan envisions each university medical center as the hub of a regional network that would include a series of community hospitals and clinics and associated medical practices. The medical center would continue to provide education, research, and service as the ultimate point of referral for diagnosis and therapy. Its obligations to community hospitals would include assistance in staffing, consultation, education, and quality control.
- By 1975 physician output should be increased by 25 percent, or approximately 2500 per year. This would minimize our reliance on the graduates of foreign medical schools and produce physicians at a faster rate to match the rate of population growth. The existing educational system can sustain a 25 percent acceleration in medical school graduates.
- A major factor contributing to the present deficiencies in health care delivery is the unbalanced national distribution of physicians. Community planning of hospital and health service facilities, combined with the modern transportation of patients, will be the most successful method to attract physicians to a particular geographic area. Indentured service is not a realistic or effective solution to the problem.
- Other reports recommend that we stimulate the production of a new type of general physician, the "primary physician," to fulfill the role of the general practitioner of the past. However, because today's physicians need ready access to sophisticated support facilities to deliver high quality care, they tend to cluster near a community or regional hospital where interdisciplinary consultations are immediately available. Such spontaneous "group practice" of the various types of physician specialists makes questionable the utility of the general practitioner. General internists and pediatricians can serve as initial contact physicians. To care for remote, isolated communities, health stations staffed by paramedical personnel can be established and maintained in contact with a medical center by a communications network and effective transportation.
- Although medical education must be improved and its costs controlled, care must be taken to maintain the quality of the physicians produced. We should not return to the generally discredited, clinical apprentice mode of medical education used in the early years of this century.

- The increase in "productivity" of physicians in this country during the past two decades is attributable largely to the use of ancillary personnel. Greater utilization of existing and new classes of auxiliary medical personnel would permit more effective and efficient use of physician skills in the direct care of patients, and would reduce the presently perceived need to educate larger numbers of physicians.
- A major objective of health professional education should be to provide manpower for health care units of varying size with combined expertise to meet the varying needs and conditions for health care. This will require more effective recruitment of faculty, more flexible curricula, and enlarged educational facilities. The financial investment, which will be considerable, presents a legitimate charge against the future benefits of improved health care, and should be made primarily in existing or new university medical centers. A major fraction of the investment will have to be made by the Federal Government, although state, private, and individual investment should be encouraged as well.
- Medical education is in the throes of a major financial crisis caused, to varying degrees, by expansion of undergraduate education of physicians, by reliance on indirect support of medical education through research grants during a period of reduced growth of support for such research, by lack of proportionate growth of private support of medical education, by general inflation, and by lack of a clearly defined federal policy with an accompanying financial commitment for support of health professional education.
- Each year approximately 30,000 students make 150,000 applications for 10,000 places in the entering classes of American medical schools. There is an annual increment of 10% to 15% in actual applicants. The majority come from well-to-do families. It is important that the medical school community include significant representation from rural, minority, and lower socio-economic backgrounds, not only to equalize opportunities but also to bring to bear new experiential and informational expertise on undergraduate and postdoctoral medical education, and to design approaches to the health care problems of urban ghetto and rural areas. The single most important impediment to recruitment and retention of students from minority and lower middle class backgrounds is the lack of financial assistance for such students. Approximately one-third of medical students require full support from some source, one-third require partial support, and one-third require no support.
- Due to reductions in student aid programs, medical schools, working within the tightest possible strictures, have had to refuse legitimate requests for support from qualified applicants, to increase the loan burden on many students above the level generally considered sound by economists and educators, to warn admissions committees that their poorer students should not count on receiving all necessary support, and that few would be able to avoid loans entirely, and to temper plans for expansion of enrollment.
- Currently available scholarships for medical students amount to approximately $10 million annually, of which approximately $8 million is derived from federal sources. Perhaps an additional $75 million is needed for student support. The Federal Government should, directly or indirectly, see that this sum becomes available. Institutional resources cannot meet more than a small fraction of this amount; few universities command significant unallocated resources. Loans through the private sector are being used, but meet only a small portion of the need because of restrictions on borrowers, high interest rates, and other limitations.
- Paralleling inadequate student support in the health professions has been lack of a coherent policy for institutional support. The educational costs of medical school operations are difficult to document, primarily because the costs of education, research, and patient care are intermingled in different ways in different institutions. Federal support to academic medical centers has not been supplied in the name of medical education itself. Although 60% of the total funding of medical school operations derives from federal sources, almost all of this represents the support provided for research and research training. Since the individuals so supported also conduct undergraduate and postgraduate medical education, American medical schools can be harmed almost irreparably by abrupt withdrawal of funds and will

slowly deteriorate if federal support declines without suitable substitute.

- To avoid arbitrary limitations upon the number of physicians produced, and to permit the career choice of medicine for all those who are qualified, it is important that the Federal Government immediately develop a stable method of financing medical education which will be independent of the level of support for biomedical research and will be affected primarily by requirements for new physicians.
- Programs to provide funds for health professional education should take at least two forms: direct subsidy to schools and assistance to remove economic obstacles to students seeking education in the health professions.
- One possible mechanism of stable support would be an educational opportunity bank. A second approach would be to institute a small surcharge on premiums for medical insurance, and place the revenues in a trust fund to cover the costs of education. Neither method by itself could be successful. If the bank operation were to depend only on revenue from repayment of loans with interest or from taxation of physicians' income, it would not meet inflation of both educational costs and financing costs. It would have to be reinforced with funds from another source, such as a "user tax" on health insurance premiums.

We Recommend

1. That the output of existing medical schools be increased by 25% by the year 1975 and that as the population grows, new medical schools be established according to regional need.

2. That the Federal Government expand the funding of medical education by direct subsidy to schools and by provision for student aid, and that current Federal Government planning and financial support for medical education not imply an obligation or a commitment to the production of large numbers of undertrained general physicians.

3. That, in addition to expanding subsidies for medical education, the Federal Government consider establishing a stable, self-sufficient system of funding medical education that would be (a) responsive to public demands for physician services, (b) reduce economic barriers to medicine as a career, and (c) balance fluctuations in direct support. In pursuing this objective, the Federal Government should explore, together with appropriate outside agencies and educational institutions, whether an educational "opportunity bank", supported in part by physician repayment and in part by a "user tax" derived from the health care system, would be an acceptable mechanism to provide funds for medical education.

4. That federal funds be made available for extensive expansion of programs for the training of physician-dependent health care personnel, and that the Federal Government (a) take steps to define the role of physicians' assistants in the health care system and to define their licensure or certification and the legal basis for their employment, and (b) draft a model law governing the training of physicians' assistants and the legal basis for their employment for consideration by the Council of State Governments.

NATIONAL HEALTH POLICY

Conclusions

- At present, no individual or group of individuals within the Executive Branch of the Federal Government has responsibility for monitoring the heterogeneous federal activities in the health field or for establishing national goals and priorities in relation to which the various programs can be evaluated, coordinated, or directed. Central control and evaluation consist largely of a retrospective tabulation of the sum of the many budgetary decisions to foster or to limit growth of individual programs.
- The absence of a formal, prospective coordinating mechanism leads to inefficiency and unnecessary duplication of programs and activities. The absence of an articulated national health policy hinders the use of federal exenditures to promote long-term objectives, to husband national resources in health, and to achieve greater efficiency and economy. The absence of such a stated policy prevents the private sector from developing programs in accordance with nationally accepted goals.
- National health policy cannot be written overnight. There is a need for an adequately staffed organization to carry out continuing policy

analysis and to coordinate planning and implementation of federal health programs.

We doubt seriously that this continuing responsibility can be discharged by any single cabinet department or independent agency because so many of them have major health and health research programs as part of their mission. Furthermore, established and long standing doctrines within the existing governmental structure concerning roles, missions, and jurisdictions, make it exceedingly difficult to graft new responsibilities for planning, evaluation, and communication onto the present machinery.

We Recommend

That a mechanism be created in the Executive Office of the President for (a) the development of a national health policy to guide federal departments and agencies and the private sector, and (b) the preparation of an annual report on national health goals and programs.

Biomedical Research and Training

INTRODUCTION

The medical profession has its roots in several branches of science and undertakes to apply the findings of science to the improvement of man's health. Traditionally, this application is made with compassion and in accordance with a widely recognized code of ethics and morality. The medical profession: (1) generates scientific knowledge about disease and teaches it to others; (2) uses this knowledge to preserve, restore, and improve the health of the individual and of the entire community, and teaches others how to do the same; and (3) evaluates all medical actions that affect a human being. The fulfillment of these responsibilities requires the combined efforts of individuals from many scientific disciplines and professional specialties. The rapid growth of science and of technology during the past two decades enormously increased the potential of medicine and stimulated a rise in society's expectations. Yet disappointment and dissatisfaction prevail because of inadequacies in the delivery of personal health services and failure to solve such social problems as poverty, malnutrition, housing, and environmental degradation.

Pressures have arisen to divert funds from the support of biomedical research to the delivery of medical care, but advocates of this policy fail to understand that it is *biomedical research that creates what there is to be delivered* and hence shapes the delivery system.

The current objectives of medical education, to develop the capacity to apply what is known today to the delivery of medical care, to develop the capacity to generate new knowledge through research, and to develop the capacity to adapt medical practice to innovations produced by research, are threatened by short-sighted efforts to "streamline" medical education to teach little more than the quickest way to apply what is already known. This form of expediency may temporarily still a clamoring public, but it disregards a fundamental tenet that a *major objective of medical education must be to prepare for the future*, not merely to conform to patterns of the past or present.

It can be forecast with confidence, based upon the accomplishments of medical research and medical practice since World War II, that it is possible within the foreseeable future to determine the underlying causes of most of the major diseases of man which are not understood today. When biomedical research reveals the underlying mechanisms of these diseases, technologies to prevent or cure them will become feasible. Although we cannot predict precisely when we will achieve such understanding for a particular disease, since basic research in human biology is by its nature unpredictable, it is increasingly likely that eventually we will understand these disorders. The extraordinary advances made in all fields of biological science during the past two decades have created a pool of information and basic insights from which we can derive the solutions to problems of human health. If existing federal programs of basic and clinical research are maintained at optimal sizes and if the training of new young scientists and investigators to carry on the effort is continued, the ultimate achievement of medicine's goals can be anticipated.

BIOMEDICAL RESEARCH AND THE TECHNOLOGY OF DISEASE CONTROL

Future Prospects

It is not unrealistic to predict that eventually the major lethal and incapacitating diseases that now

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afflict mankind will no longer be significant problems in our society. This does not mean, of course, that they can be eradicated but *virtual freedom from disease is now no more visionary a notion for human beings than it is for valuable stocks of domestic animals or for agricultural plants.* Its general achievement, given the availability of adequate resources for research, should be attainable within this century, and for many diseases effective control measures can be expected within the next decades.

There are, of course, major diseases for which fundamental research has already led to effective control measures. In the absence of such technology many of these diseases would be causing prolonged disability, and their higher mortality would severely tax today's faltering health care system. A prime example is the group of infections now treatable by chemotherapy. There is an understandable tendency to forget that our present ability to control most infections of man did not develop empirically or accidentally. Modern chemotherapy and immunization rest on a solid foundation of knowledge acquired through basic research in the early decades of this century. In addition, more recently, certain diseases due to metabolic disturbances unrelated to infection, such as hyperthyroidism, gout, and pernicious anemia, have come under effective control largely as the result of basic research into their underlying mechanisms. Today's roster of major lethal diseases that no longer need pose massive economic problems of public health includes, in addition to those already mentioned: epidemic meningitis, infantile diarrhea, epidemic typhus, trachoma, scarlet fever, cholera, yellow fever, bacterial endocarditis, typhoid, leprosy, syphilis, gonorrhea, lobar pneumonia, malaria, pellagra, rickets, scurvy, erythroblastosis fetalis, Addison's disease (adrenal insufficiency), juvenile diabetes, recurrent rheumatic fever, measles, rubella, whooping cough, diphtheria, smallpox, tetanus, puerperal sepsis, neonatal infection, certain types of cancer, and many others. This list is incomplete but it illustrates that when *measures are available for controlling or preventing life-threatening diseases, these measures are, in general, relatively simple and inexpensive*, and that these diseases tend no longer to pose great problems of logistics, manpower, and cost for the health care system in this country.

Dr. R. W. Berliner emphasized this point most cogently:

> "The impression is widespread that advances in medical research only increase the demands for complex and manpower-intensive medical care. The most spectacular of current procedures—open-heart surgery, coronary intensive care, dialysis, transplantation—naturally attract attention. Less apparent are the patients who might have been hospitalized, but are not because preventive and very simple therapeutic measures have made their hospitalization unnecessary." (*The Relevance of Medical Science to Medical Care*, R. W. Berliner, Archives of Internal Medicine, Volume 125, March, 1970, p. 510)

When the diseases now confronting us have been controlled or eliminated, it is probable but by no means inevitable that other disorders will emerge or become more prominent. Some of these may originate from man-made alterations in the environment. There is no reason to suppose, however, that they will be so mystifying as to elude solution by the medical science of the future. It takes no great leap to imagine a future stage of scientific understanding sufficient for the control or elimination of virtually all disease. This is not a utopian vision, man will still have an abundance of problems to solve; the forecast is simply that eventually today's roster of major diseases will be among the least of his concerns.

Medicine, as a scientific discipline, will have new opportunities to enter fields of endeavor for which as yet there do not seem to be links to today's biological science, or for which a sufficient volume of usable knowledge has not yet been accumulated. As in the past, society will expect physicians to alleviate all forms of human anguish, to deal with "social" problems such as alcoholism, drug abuse, deprivation, suicide, trauma, malnutrition, and the neuroses associated with overwhelming changes in the structure and complexity of society. Medicine's capacity to make meaningful contributions in these areas will increase only when there are concomitant advances in the social and behavioral sciences and, in the future, medicine will become increasingly dependent on the progress of basic research in these fields as well as in biology.

Incomplete or "Half-Way" Technology in Medicine

A large part of the high cost and complexity of medical care today is attributable to what may be termed "half-way" technology, representing partial solutions or palliative measures for major diseases for which the underlying mechanisms are not yet understood.

It is the record of recent decades that each time a major disease has come under control, either through prevention or cure, the solution has been much simpler and less costly than the technologies devised during earlier stages of incomplete knowledge. Moreover, each time this kind of advance has occurred, it has been at least in part the result of fundamental insight into an underlying mechanism of disease provided by basic research.

The outstanding examples of this kind of change in technology are to be found in infectious disease. The construction and staffing of specialized hospitals for tuberculosis, and the elaborate facilities for surgical treatment of infected lung tissue were all rendered obsolete by the development of chemotherapy, and the cost of tuberculosis to society was promptly reduced by orders of magnitude.

Before the discovery that there were three distinct immunological types of poliomyelitis virus, and the successful cultivation of these agents in tissue culture, poliomyelitis could be managed only by immensely costly hospital facilities (including iron lungs and intensive nursing), and with what then seemed a high technology developed at great expense. The present outlay for virtually complete control by prevention of poliomyelitis is the cost of vaccination.

Parkinsonism illustrates the same point in another field of medicine. In its progressive, advanced stages, this disease has required elaborate facilities for chronic nursing care; in certain cases neurosurgical procedures have proved helpful, but the cost of applying these to the great numbers of people with the disease has been prohibitive. It now appears that the discovery of the effectiveness of the drug L-dopa will make it possible to restore normal function, and the cost is certain to be very much less than that of the measures employed previously. Other examples of the cost-effectiveness of disease control derived from understanding of basic mechanisms abound but will not be included in this report.

Today's most conspicuous example of "half-way" technology is the use of the artificial kidney or renal transplantation for the treatment of renal failure. Here, the underlying disease is usually some form of chronic nephritis, the basic mechanisms of which are not yet understood. However, it is gradually becoming evident that in some forms of nephritis, immunologic complexes formed by antigen and antibody of various origins are entrapped in the capillary walls of the renal glomeruli, with subsequent renal failure. When we learn how to combat the disease by measures to prevent or reverse this precipitation, the need for costly and only partially effective substitution or replacement of human kidneys will disappear. Similarly, the current pressures for a new technology for artificial mechanical hearts, and the recent efforts to transplant human hearts, are manifestations of *our lack of adequate information concerning the basic mechanisms of disease in cardiac muscle fibers and heart valves.*

There are some disorders in which important advances in technology have occurred despite only limited understanding of their underlying mechanisms. These advances produce significant prolongation of life and relief of suffering without the immediate prospect of cure or prevention. Examples are the supportive measures based on insight into the importance of electrolyte balance in shock, infection, kidney disease, and convalescence after major surgery. The techniques of surgery have been transformed; open-heart surgery is only one of the more conspicuous examples of the sophistication being achieved in all branches of this specialty. Diabetes has been changed from an incapacitating illness to a relatively minor inconvenience for many patients, even though the underlying disease process is still unsolved. The epilepsies can be sufficiently modified by drugs to permit normal lives for many epileptics, although the fundamental causes of this disorder remain obscure. Malaria has been eliminated as a threat to the survival of whole societies, although resistant strains of parasites and vectors continue to emerge in some parts of the world. These examples of partial progress toward solution emphasize *the need for continued research* to achieve definitive control measures in the future.

Need for New Knowledge

The list of major human diseases for which we lack definitive measures for prevention or cure is

still formidable. *It is in the management of these diseases that the present deficiencies of our health care system are most visible and frustrating, not primarily because of shortages of professional manpower or hospital facilities but because so little is available in the way of truly effective technology. These major diseases pose the most formidable problems for any health care system of the future.*

The list includes stroke, heart attack, congestive heart failure, most forms of cancer, atherosclerosis, cirrhois of the liver, emphysema, glomerulonephritis, pyelonephritis, rheumatoid arthritis, osteoarthritis, acute rheumatic fever, disseminated lupus erythematosus, asthma, multiple sclerosis, senile psychosis, schizophrenia, depression, genetic disorders of metabolism, mental retardation, muscular dystrophy, cystic fibrosis, many disorders of the skin, and virtually all of the virus diseases that are not preventable by vaccines.

We do not imply that nothing can be done for patients with these diseases, since there are virtually no diseases for which medicine cannot provide some type of treatment, but this often means "caring for" rather than curing or preventing. It is a basic obligation of medicine to provide increased comfort, to relieve pain, and to alleviate anxiety. These efforts are often extremely time-consuming and expensive, and increasingly difficult to undertake in our expanding urban settings. Were it not for the effective technology which already exists for those diseases that can be promptly cured or prevented, the demand upon this "caring" function of medicine would long since have exceeded supply. As matters stand today, the supply is woefully limited. *The problem may be alleviated temporarily by increasing the number of physicians and other members of the health manpower pool, but for the longer run the only sure solution lies in strengthening the science and technology of medicine for all of the diseases in question.*

The problem can be illustrated by the disease rheumatoid arthritis, which afflicts at least 5,000,000 Americans of ages ranging from early childhood through middle age, many of whom become totally incapacitated by the destructive lesions of their joints. The etiology of the disease is unknown. The basic mechanisms responsible for joint damage are not understood. The most useful therapeutic agents are the salicylates or related "anti-inflammatory" drugs, and the corticosteroid hormones, but their use is based on empiricism. They may diminish pain and disability but they do not affect the duration or eventual outcome of the disease. As in any chronic, relentless disease, reassurance and moral support are constantly needed, for the family as well as the patient. Specialized technical personnel, including nurses, physiotherapists, occupational therapists, rehabilitation technicians, and psychologists are all involved, at one time or another, in "managing" rheumatoid arthritis. Entire hospitals have been constructed and staffed at great cost exclusively for the treatment of this one disease. The whole array of modern medical "care" for arthritis is impressive and valuable, and often succeeds in transforming misery to something approaching comfort and equanimity, but cannot alter the natural history of the disease or change the process of joint destruction.

Now there is suggestive evidence from several research laboratories indicating that an infectious agent, one which provokes an inappropriate immune response, may be closely involved in the causation of rheumatoid arthritis. It is useful to consider what the effect would be on the public health problem posed by this common disease if a microbial agent were, in fact, found to be a primary factor in its cause. Some form of effective chemotherapy would eventually be found, and some form of immunizing vaccine would be developed. If this were to happen, rheumatoid arthritis would certainly become as minor a problem for the health care system as are poliomyelitis and diphtheria today.

Thus, rheumatoid arthritis is a disease problem awaiting solution, and the most likely sources of new information concerning its mechanism are the basic disciplines of virology, cell biology, microbiology, and immunology.

A similar assessment can be made for most of the other major human diseases posing unsolved problems. A clear understanding of atherosclerosis seems to be dependent, at the moment, on new knowledge of the physical chemistry of lipoproteins and of the physiology of arterial walls. Coronary thrombosis and stroke are problems which cannot be solved until the linked mechanisms involved in blood coagulation are more clearly defined. Multiple sclerosis is believed by some to be an immunologic disease, and models in experimental pathology for the production of autoimmune disease are under investigation for possible clues. The new virology and cell biology

are yielding information which seems directly relevant to the transformation of normal cells to cancer cells. The structure and function of biological mebranes now assume the aspect of a whole new science, with new implications for diseases affecting the heart, the neuromuscular system, the kidneys, and the digestive tract. The science of genetics has revealed basic mechanisms that are central to the pathogenesis of congenital diseases involving crucial enzyme systems in infancy and childhood. Developmental biology is evolving techniques and new insights into the reproductive process which may contribute decisively to the problem of population control.

Indeed, today few human diseases pose apparently insoluble problems, although development of the solutions may require long and arduous efforts. Major advances in various fields of biological science have provided new and encouraging leads for research. If some of the leads are tenuous or even prove false, if more basic research is required, nevertheless the enhanced possibilities for progress have generated among clinical scientists an atmosphere of excitement and optimism as to the eventual outcome. These investigators believe that, however faintly, at long last they can discern the approaches to the problems of prevention and cure of major diseases.

When these problems are solved by what promises to be difficult and often disappointing research efforts, other problems will remain and emerge in prominence. Foremost among these is that of aging. When man is no longer stricken by today's major diseases, he will still grow old and die, and both society and the medical profession will have to cope with the physiological and psychological difficulties that will necessarily arise within an aged population. These problems are not considered in this report because the more immediate ones related to the conquest of disease pose a sufficient challenge for the decades ahead. However, the problems of aging demand attention too. They are to be examined at a forthcoming White House conference. Basic research into the mechanism of aging should be further encouraged.

Conclusions

Modern medicine has derived much of its effective technology from antecedent advances in basic biological research, and it must continue to do so if it is to gain control over the major diseases still on its agenda. *It is the lack of effective methods for prevention or cure of these diseases that poses the greatest problem for any future health care system.* On the basis of past record, it is argued that "half-way" technologies, and the stop-gap measures of disease management that are necessary when the underlying causes of disease are not known, are almost invariably more complex and costly than are the definitive methods that are developed when a disease problem is solved. Whenever a technology has brought about prevention or outright cure, it has proved to be relatively simple and relatively cheap, in contrast to the elaborate and costly endeavors associated with incomplete knowledge and the ability only to "care" for the patient.

It is our view that the provision of a satisfactory health care system for the long-term future will be centrally dependent upon advances in the science and technology of medicine. For those parts of medicine concerned with "social" problems such as alcoholism, suicide, certain forms of violence, narcotic addiction and other forms of drug abuse, we forecast the same future. The amount of basic science information available for application to these problems is, however, considerably less than that in the traditional biomedical fields. Basic research in the social and behavioral sciences is therefore needed on a larger scale than we have yet known.

There are important implications in this for medical education. If the science and technology of medicine were static and unchanging and if we were to expect no new advances in the understanding and therapy of human disease, new physicians could be trained by the book and by rote, as technicians, to learn today's methods for the management of disease as matters of doctrine. But if the scientific understanding of disease processes is to be continually enhanced and changed, and new forms of treatment are to be based on this new information, then there can be no question about the "relevance" of basic biological science to the education of physicians.

MEDICAL-SOCIAL PROBLEMS: MENTAL HEALTH

The foregoing account of disease and of the relevant health care issues describes the situation

in the United States in 1970, and provides a basis for the unconventional and even startling prediction that disease as we know it today can be largely eliminated in the foreseeable future. Our current definitions of health and illness, and of the responsibilities of the medical profession, however, are not likely to stand still. For the history of medicine is a continuing redefinition of the unacceptable, and the problems of the future may have few precedents in the medicine of today. *Such precedents as do exist suggest that a major source of change in the nature of medicine, and of the problems with which it deals, lies in the borderland between medical and social issues.* At certain propitious times the boundaries of medicine have been extended into this borderland so that what had been regarded as social or welfare problems came to be defined as illness. When the social climate has been supportive, and when the relevant medical technology has been sufficiently effective, this redefinition has added significant new dimensions to the domain of medicine.

One of these major redefinitions of the domain of medicine occurred 200 years ago when the French physician, Pinel, selected out of the great mass of the socially disabled—criminals, paupers, mentally retarded—certain persons suffering from discrete disturbances which came to be labeled as mental illness. Demonstration that these persons could be handled more effectively by what was known as "moral treatment of the insane" than by traditional custodial care established their disturbance as a form of illness and their management as a form of medical treatment. The branch of medicine which has assumed a major role in the treatment of the mentally ill, psychiatry, has shared in the accomplishments described before, and shares the anticipation of further progress. For example, each year for over a century the number of patients confined in mental hospitals increased and mental patients came to occupy over half of all the hospital beds in our country. Then, in 1955, the introduction of new treatments brought about an historical turning point at a time when the patient population had reached 559,000. The following year, for the first time, the number of patients in mental hospitals did not increase and, in fact, declined. This decline has continued in each of the succeeding years and the initially slow rate has increased so that the population has now fallen below 400,000. The decrease in hospitalized patients is the more remarkable in that it has occurred despite the continuing rapid increase in the population at large, and thus of the population at risk of suffering mental illness. As Figure 1 shows, the real extent of the achievement is conveyed not alone by comparison of the 1968 figure of 401,000 with the 1955 peak of 559,000, but perhaps even more meaningfully with the figure of 731,000 which would have been reached by 1968 had the earlier rate of growth continued.

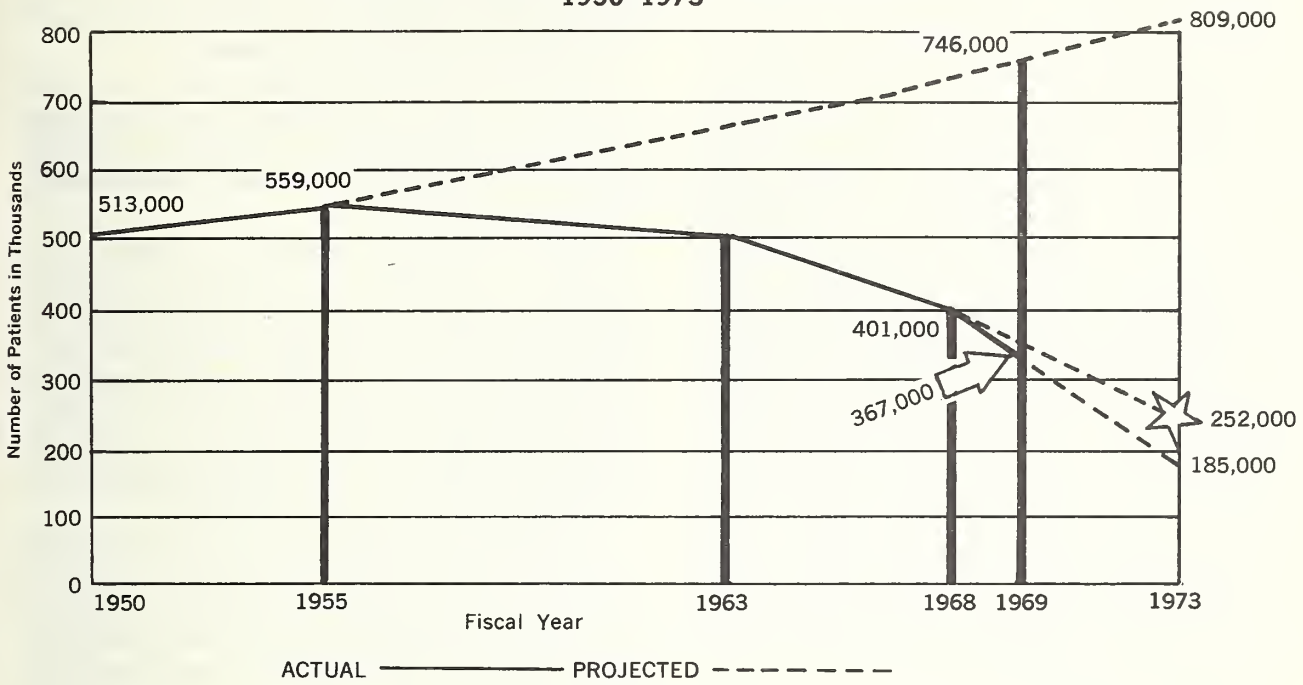
The most gratifying aspect of this improvement in therapy is the prevention of one of the most painful kinds of human suffering. But the economic benefits during the period since 1955 are worthy of note: (1) a saving of over six *billion* dollars in hospital construction costs, (2) a saving of over six billion dollars in patient care costs, and (3) a vast increase in the productivity of persons who would have formerly been totally removed from the labor market.

The encouraging results of even the relatively small amount of psychiatric research undertaken to date are ample reason for optimism about the fruits of further research. Problems for which there are as yet no solutions are much greater than those which have so far yielded to our efforts. The reduction in the number of patients resident in mental hospitals has been achieved by reducing the duration of illness episodes, but the number of such episodes has not been reduced and the number of patients admitted to mental hospitals has actually continued to rise. Furthermore, although ability to live outside a hospital is an important advance, for many patients it represents only a lessening in the intensity of an illness which continues to severely limit their effectiveness and well-being. Finally, there remain the large numbers of patients still confined in hospitals, despite all our efforts.

Although we have made progress in coping with many of its symptoms, as yet we have no definitive treatment for schizophrenia. Until such treatment is developed by further research, this most severe of mental illnesses will continue to exact a heavy toll. Thus, two percent of the population will at some time suffer from schizophrenia, with all of its pain and disability and all of its disruptive effects upon other family members. If even a small fraction of the funds now devoted to the custodial care of those schizophrenics still in our mental hospitals were invested in research into the causes and cure of schizophrenia, it could dramatically improve this gloomy outlook.

Figure 1

PROJECTED AND ACTUAL NUMBERS OF RESIDENT PATIENTS
END OF YEAR, STATE AND COUNTY MENTAL HOSPITALS
1950–1973



Source: National Institute of Mental Health

The example of mental illness can serve as a precedent in viewing those disorders in the borderland between the medical and the social, which are reaching epidemic proportions. To many of them medicine may be able to make useful contributions and, for some, medical intervention may be of very great importance. Growing social disorder, including particularly youth unrest and the new drug culture, is a matter about which we know remarkably little, and new information may be required to prevent deterioration in the quality of life in our nation. The very scope of the problem, which in many ways challenges the basic values and incentives of our way of life, is such that only a broad program of research seems likely to offer any chance of dealing with it. *Starting late and already far behind the confused and chaotic events of the day, this basic research in the social and behavioral sciences requires greatly expanded support lest the problems outstrip our ability to cope with them.*

An example of the potential benefits to be reaped by the application of medical technology to a medical-social problem is provided by recent developments in the treatment of drug addiction. Addiction, particularly to heroin, has become a symbol of the deterioration of the inner city. Seventy thousand heroin addicts are known to the police and most authorities estimate that there are two to three times that number and that the problem is growing rapidly. Death from heroin was formerly a small problem, confined to older, "hard-core" addicts. It is now *the leading cause of death* in the age group between 15 and 35 in New York City. The figures for deaths in this group for New York City in 1969 were (data provided by Office of Chief Medical Examiner, City of New York):

Narcotics	770
Accidents	570
Homicides	525
Suicides	345
Cancer	420

For all age groups, the deaths from drug abuse in New York City reached 950 last year. The striking rise is shown in Figure 2.

Six years ago medical research demonstrated that the oral administration of small doses of methadone, a synthetic pain-killer, not only re-

lieved an addict's craving for heroin, but also blocked the euphoria, the "high", which helped to sustain his habit. A few properly supported and staffed pilot programs of methadone maintenance therapy which have been started since then have been strikingly successful. One year after beginning treatment 70 percent of heroin addicts in these programs are not only heroin-free (as determined by routine urine tests), but also working (Dole, V. P., Nyswander, M., and Warner, A., Journal of the Amer. Med. Assn., Vol. 206, 1968, pp. 2708 to 2711; and Wieland, W. and Chambers, C., Internat. Journal of the Addictions, Vol. 5, 1970, in press). The costs of such programs range from $4,500 to as little as $1,000 per addict per year. Compare this with the $80,000 which is the estimated cost to society per addict per year from theft alone. It appears that medical research has made a major contribution to a pressing medical-social problem. Implementation of this effective and inexpensive technology needs funding. Today less than four percent of known addicts are receiving methadone maintenance therapy and some programs have actually been terminated for lack of funds.

At the present time no technology as effective as that for heroin addiction is available for any of our other growing medical-social problems and even in clearly defined problem areas our ignorance is vast. Marijuana, which may well be used by over one-fourth of our college and high school students, is very poorly understood as a pharmacological agent. The discouraging record of management of this problem compiled during the past 30 years by non-medical agencies suggests that redefining marijuana-smoking as a medical as well as legal problem is long overdue. For by so doing we can bring to bear the appropriate research, treatment, and rehabilitation measures.

Another problem at the interface of medicine and society, one that is greater than that of narcotic addiction or other drug abuse, is alcoholism. More than five million Americans are alcoholics; alcoholism is the cause of over 11,000 deaths a year, not counting the half of the 50,000 automobile accident fatalities attributable to drinking. The total cost to the nation of this illness is approximately $2 *billion* a year. Very little medical attention of any kind is being given alcoholism today, and alcoholic patients continue their unhappy rounds of "drying out" in city hospitals, expensive private hospitals, or jails, only to return to drinking. Even if we were to expand our current treatment efforts a hundred-fold, we would then merely "manage" our alcoholics with an expensive half-way technology. Only *research* offers any hope of new treatments which will enable us to deal with this major problem definitively and effectively.

Research in child development deserves special attention because of its promise for developing means of solving many medical-social problems and making significant contributions to the quality of life in America.

Seventy years ago, Freud first proposed that childhood is critically important for all later personality development and functioning. This prescient speculation lay largely unexplored until comparatively recently, when research provided extensive support for it. Evidence from the entire range of biological and social sciences has shown that every aspect of the developing organism is exquisitely sensitive to early influences.

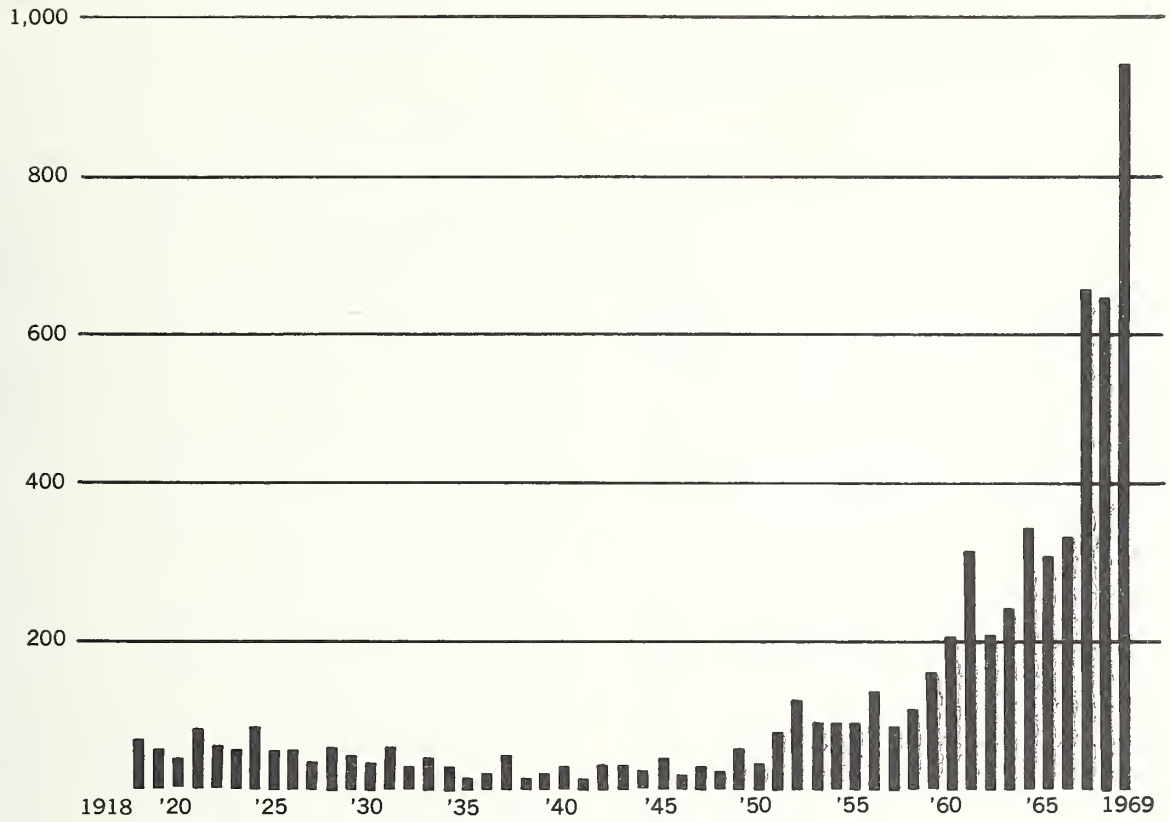
A few brief examples of the fruits of research into various stages of child development will illustrate the many opportunities offered by investigations in this field. Discovery of the biochemical mechanism in PKU (phenylketonuria) made possible prevention of the mental retardation which was formerly an almost inevitable outcome of this inherited disorder and set a precedent for control of similar diseases. Other disorders which are not inherited are already present at birth because of unfavorable events in the womb. Thalidomide has alerted us to the problem of prenatal vulnerability to drugs; and maternal rubella, formerly a major cause of congenital deformity, is now preventable by specific immunization.

Many children escape the effects of genetic disorders and of prenatal distress only to be born to an early environment which permanently disables them. The best documented instances are normal children assigned to orphanages because their parents are unable or unwilling to care for them. Follow-up studies of such children show that many suffer permanent damage, both intellectual and social. Research demonstrating the harmful effects of maternal deprivation has brought about major changes in the practices of social workers and juvenile courts. Instead of the former often routine placement of unwanted children in orphanages, every effort is now made to secure adoptive or foster parents.

Still other children, born healthy, are abused and assaulted by their parents. Research on the

Figure 2

DEATHS FROM NARCOTICS ABUSE IN NEW YORK CITY
1918–1969



Source: New York City Medical Examiner's Office
(Published in The New York Times, June 21, 1970, p. 58)

Value for 1969 is preliminary

"battered child syndrome" has thrown into bold relief a tragic and self-perpetuating social problem, for those battered children who survive their parents' assaults will themselves often grow up to be assaulting and aggressive parents.

Much of our research on child development has centered on children's intellectual growth. Perhaps even more urgently needed is knowledge about their social growth, their gains in skills in getting along with others. This issue is highlighted by social psychological experiments which have demonstrated how effectively even short exposures to televised violence can induce subsequent aggressive behavior in children. Surely such a powerful instrument must also have a powerful potential for good. The past year's experience with "Sesame Street", a program conceived by behavioral scientists, suggests that this is so. (Fred Hechinger, New York Times, November 8, 1970)

The experience of the recent past makes it clear that we can neglect these new medical-social problems only at great peril. Attention to them, furthermore, may do more than prevent disorders; it could liberate the energies and idealism of an unusually well-endowed generation.

In summary, if history is any guide, the tasks assigned to medicine in the future will expand to include not only the treatment of disease but also responsibility for problems not now viewed as medical. Many of these problems now lie in the borderland between medical and social responsibilities and their alleviation will move us towards health as the World Health Organization has defined it—not solely the absence of disease but also complete physical and mental well-being. The medicine of the future will seek more than the

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relief of suffering and the preservation of life; it will be increasingly concerned with improvement of the quality of that life.

SUPPORT OF BIOMEDICAL RESEARCH AND RESEARCH TRAINING

Federal support for biomedical research during the past two decades has brought us to the threshold of an era in which our unparalleled national capability to explore the fundamental causes of disease, if it is not impaired by lack of continuing support, will produce many discoveries that will not only influence the life and health of individual Americans but also help to establish a pattern for restructuring our entire system of health care.

The high quality of American biomedical research and teaching is recognized by most other countries. Physicians and scientists from virtually all nations now come to the United States to work and study as they once went to the great centers of Europe. Federal support of the research endeavor has led to an understanding of basic life processes in molecular terms, and this understanding has generated hope that in the future we will be able to cope with the major crippling and killing diseases which affect man, particularly in his youth and middle age. With federal support, the nation's universities and their medical, dental, veterinary, and public health schools have become both educational instruments of exceptional quality and the primary institutions for the conduct of research.

Growth of Biological and Biomedical Research

The impressive growth and maturation of the American biomedical research enterprise during the past twenty years, although due in part to an increase in private philanthropy and foundation support of institutions of higher learning, are attributable primarily to federal support of basic and clinical research and research training. The chief instruments of the federal support have been grants-in-aid from the National Institutes of Health, the National Science Foundation, and the Atomic Energy Commission, and research contracts from the Departments of the Army and Navy, now the Department of Defense.

In 1944, the Public Health Service Act extended to the National Institutes of Health the basic authority for awarding research grants to non-federal establishments and authorized the awarding of research training grants.

After a modest start, support for NIH programs increased more than five-fold to $430 million between 1955 and 1960. In fiscal year 1965 the total amount exceeded $1 billion. By fiscal year 1970, the NIH budget was over $1.4 billion, but a leveling off had started in 1966 and today cutbacks of significant magnitude in specific categories are creating grave concern within academic medical centers because these institutions have become financially dependent upon government grants to an extraordinary degree. Monies awarded as grants for research, research training, and research construction served their primary purposes well indeed, but they also indirectly provided a substantial fraction of the support of graduate and medical education and of specialized patient services. The cutbacks in the three research support categories, together with accelerated inflation, have resulted in real reductions in purchasing power of 10 to 15 percent per year over the FY 1967–1971 period (as projected). *These dollar deficits are occurring while academic centers are struggling simply to maintain present levels of operation. In addition, the centers are under pressure to expand the size of medical classes, to increase output of paramedical personnel, and to assume an even larger and more central role in the health care enterprise itself.*

The abrupt slackening of financial support for biomedical research and training that began four years ago, and which continues unabated, has resulted in a steady erosion of the entire system, and the cumulative results are becoming alarmingly evident:

- ongoing research programs of high quality and demonstrated merit have been curtailed; some are now threatened with termination by the lack of funds.
- teams of scientists and technicians painstakingly organized over many years are being disbanded.
- training and educational programs, the vital sources of the academic cadre required to meet the Nation's urgent and growing needs for more health professionals, are faltering; some have been forced to shut down completely.

- younger scientists are finding increasing difficulty in obtaining support for exploration of new areas of great promise.
- areas of biomedical science which might generate alternative approaches to the control of important diseases are inadequately exploited simply because there are no funds to enable forward movement.

It is ironic that the apparent lack of a consistent federal policy is allowing this long-cultivated, intricate, and highly productive system to dissipate by default and neglect at a time when the direct federal commitment to the health care of the country's children, aged citizens, and disadvantaged groups is deepening and when the application of the results of scientific research to the delivery of health care will be needed more than ever if the commitment is to be met. It is doubly ironic that it is this very commitment to health services which limits budgets for health research. The reason is that both activities are major programs of the same unit of the Executive Branch—the Department of Health, Education, and Welfare—and under present budgeting policies an expenditure ceiling is allotted to DHEW as a single item.

Because expenditures for Medicare and Medicaid are not directly controllable, increased expenditure requirements for these health care programs must be absorbed at the expense of other programs of DHEW rather than by reductions in other departments and agencies of the Executive Branch.

This rigid grouping of "health" funds means that it is impossible to balance priorities for achieving national health goals against those for achieving other national goals. As a consequence, the realistic achievement of our overall health objectives is progressively thwarted by this artificially forced conflict between health care and health research within DHEW. It is this arbitrary procedure that has engendered unproductive preoccupation with fund allocations within a "health dollar." Under this process the essential components of a sound national health effort—the education of health professionals, the delivery of health care, and research at both the basic and applied levels—have been placed in damaging competition.

In a panoramic view, the Ruina Committee of 1966 (Report of the Secretary's Advisory Committee on the Management of NIH Research Contracts and Grants, DHEW, March, 1966) divided the postwar development of NIH programs into four periods: (1) 1945-1950, during which the initial shape was formed, the Division of Research Grants was established, first training grants were awarded, and categorical institutes were founded; (2) 1951–1955, when extramural policy and procedures were developed, advisory and review mechanisms were shaped, emphasis on basic science increased, and intramural programs expanded; (3) 1956–1960, years of growth when the deficit in research support was overcome, a major investment in resources was made through the Health Research Facilities Act, training was expanded and general research support of institutions and salary support of developing and mature research scientists were provided; (4) 1961–1965, a period of maturation during which policies and procedures were assessed, program framework was rounded out, the Division of General Medical Sciences was established, child health was emphsized, developmental research received greater emphasis, and a new concern with transmission of knowledge and technology emerged.

A fifth period, from 1966 to the present, may now be added. These years have been marked by a restructuring of the Public Health Service, a limitation on growth of NIH programs, a greater emphasis upon applied research and upon "health relevance" of basic research, and emergence of environmental health research and of contract mechanisms for goal-oriented programs. These years have also been marked by several concomitant and constraining developments—increasing competition from budgets for national defense and the space program, inflation, evolution of the new doctrine of adequate medical care as an inborn right of every citizen and of the Medicare-Medicaid programs for financing medical care for the aged and indigent, and a growing public frustration over the rising costs of medical care and over the inability of our health care system to respond promptly and adequately to new and escalated expectations. *The tenor of the times has brought into question, or at least under reassessment, the priority formerly accorded the biomedical research enterprise within the federal budget. The objectivity of the reassessment is severely compromised by the economic and political realities of competition for limited funds between research programs and medical care programs within a single administrative department of the Federal Government, namely, Health, Education, and Wel-*

fare. This competition must be reduced or eliminated, by administrative or organizational change, since medical care and biomedical research are inseparable features of a single objective—better health for all of us.

Federal Policy for Biomedical Research and Training

This report attempts to provide a basis for development of a federal policy for biomedical research and research training which is socially rational, educationally defensible, politically realistic, and financially sound. Of prime importance are the following tenets:

- All advances in the cure of disease and the alleviation of suffering are ultimately dependent upon biomedical research.
- Basic research is indispensable to subsequent mission-oriented research and development, and ultimate practical application.
- Progress in biomedical research and medical care requires substantial and continuous support of the sources of progress, namely, research itself at all levels, manpower to conduct research, facilities to house the research and research training activities, and the education of physicians in an environment of scientific inquiry and clinical excellence.
- Federal support of biomedical research and research training during the past two decades has already led to signal medical achievements.
- The biomedical research effort is but one component of health care capacity. The effort, although defensible on its own merits, was not designed as a delivery system. The current stresses upon the delivery system are not evidences of failure of the research effort, rather they are in part attributable to the high cost in dollars and professional manpower of partial solutions, of half-way technologies and of the rising expectation of the public for the care made possible by the advances of biomedical research. The problems of delivery are urgent, and require their own solutions, but a *reduction in the biomedical research and research training effort is a mortgaged solution with unacceptable consequences, namely, reductions in the rate of medical progress, in the quality of medical education, and ultimately in the health of the American people.*
- Acknowledgment by the Federal Government of the goal of adequate medical care for all citizens, and the assumption by the Federal Government of the financing of care for the aged and indigent, leads, we submit, to a logical corollary: the development of a national policy of stable support of all those measures which will ensure continued progress in the attainment ment of the goal, including adequate financial support of basic and applied research, and of facilities and manpower needed to conduct research, and the modifications of the system of delivery.

Continuum of Basic and Applied Research

Basic research is primarily concerned with the creation of new knowledge, and applied research with the application of knowledge to the solution of specific problems. Improvements in the diagnosis and treatment of disease rest upon applied research and clinical investigation, which in turn rest upon advances in basic research that is not mission-oriented. A study entitled "Technology in Retrospect And Critical Events in Science", (prepared for the National Science Foundation by the Illinois Institute of Technology Research Institute, December, 1968) examines five innovations of great social and practical significance including the oral contraceptive pill and the electron microscope. *In all cases studied, basic research provided the origins from which science and technology could advance toward these innovations.* Of specific key events documented, 70 percent were classified as research that was not mission-oriented, 20 percent as mission-oriented research, and 10 percent as development and application. Of the research events identified as not mission-oriented, 76 percent occurred in university or college laboratories, and 24 percent in research institutes, government laboratories or industry. Of mission-oriented research events identified, 31 percent occurred in universities and colleges, 15 percent in research institutes and government laboratories, and 54 percent in industry. Of development and application events and enterprises, 83 percent occurred in industry. The number of non-

mission events peaked significantly 20 to 30 years before the innovation, whereas mission-oriented research events and those in the development and application area peaked during the decade preceding the innovations. Ten years before the innovation, that is shortly before its conception, approximately 90 percent of the non-mission research had been accomplished.

It is clear that innovation for the next generation depends on today's research that is not mission-oriented and that this basic research takes place chiefly in the university and college. The findings in the NSF study apply with equal force to innovations in medical practice and industrial technology. For example, the suggestion that hormones could be applied to birth control originated twenty years before a direct effort toward that application was made. This suggestion, in turn, rested upon at least fifty years of chemical and physiological research on steroid hormones, virtually all of which was of a basic or non-mission character.

The argument for support of basic research and creation of new knowledge is perhaps not easily grasped by the public because there is no direct correlation between the flow of new knowledge and new products. Scientific knowledge may be pictured as a stock from which technology draws. New knowledge may be pictured as an input into this stock of organized knowledge.

> "The stock at any one time, however, is large relative to the flows both 'in' and 'out.' Further, of course, the outflows do not diminish the stock in the usual sense: while the same invention cannot be made twice, the same scientific principle can be embodied in a multitude of different inventions. And once in the stock, the knowledge remains available at a cost that is essentially zero, measured in a relation to the costs of acquiring it. This metaphor makes plainer one of the key aspects of the relations between science and technology, that there need be no close temporal connection between the flow of new scientific knowledge and the flow of new applications in technology. Such spectacular examples of very rapid translation of new science into new technology as the transistor and related solid-state devices must be balanced off against examples of lags of the order of a century, such as the application of matrix algebra to aerodynamics and the analysis of communication networks.
>
> "The metaphor of the 'stock' of scientific knowledge has its limitations too. 'New science' is not merely, or even chiefly, an addition of more of the same to the existing stock. Frequently, and perhaps most importantly, it is a transformation of some larger or smaller part of the existing stock of knowledge. Thus the 'size' of the stock bears no more simple relation to the inflow of new knowledge than it does to its outflow in technology." ("The Higher Learning, The Universities and the Public", Carl Kaysen, Princeton University Press, 1969, pp. 44–45)

The above metaphor emphasizes that it is not possible to state how much input of new knowledge is required per year for a given amount of economic growth or for the cure of a particular disease. Both economic growth and improvement of health are dependent on the stock of scientific knowledge and even though the stock is not depleted by use, additions to it are indispensable for progress.

The difficulty of quantification is compounded by two other factors. The first is that the same body of new knowledge may be relevant to a variety of purposes. The new science that is relevant to defense also may be relevant to health.

> "The second [factor] which is the converse of the first, is that the sphere of usefulness of a particular item of new knowledge is highly uncertain and difficult to foresee. This wide variability in area of application, as well as in timing of potential benefits, again makes difficult a division of responsibility—in financial terms—for different kinds of science to different functional areas of government in any consistent and exhaustive way." (Carl Kaysen, loc. cit., pp. 48–49)

The question is repeatedly raised, particularly in recent months, whether there should be any research supported by federal agencies which is not directly relevant to the mission of that agency. It is evident that every federal agency has a stake in basic research and creation of new knowledge, which may at the moment have no obvious direct application. We submit that *every federal agency has a responsibility to continue to expand the store of new knowledge in its own scientific area.* It is important that this vital function of each agency be supported very strongly in the future as in the past. An exact figure cannot be given concern-

ing the percent of the budget of any agency which should be devoted to this purpose, but 5 to 15 percent is not unreasonable. The amount will vary from agency to agency, as will the areas of basic research to be supported. It is also vital to an agency to maintain contact with scientists who are engaged in basic research. The flow of knowledge from the basic to the applied occurs best when the basic scientist has some knowledge of the applied field. This is the reason why medical centers need basic scientists on their staff, why industry hires university professors as consultants, and why the military needs a close liaison with all types of basic scientists—biologists who may relate to the problems of health and care of the military personnel, as well as physicists, mathematicians, and engineers who can relate to the latest technology of weapons and defense strategy.

The Coupling of Research and Education

The coupling of research and education may be understood by considering the functions of centers of higher education today. These functions may be itemized as follows (Kaysen, loc. cit., pp. 6–8):

- *Creation of new knowledge* by research and integration of new knowledge into the total stock of knowledge.
- *Transmission of knowledge* to the new generation by teaching: (a) general knowledge (cultures); (b) expert knowledge (training of specialists and professionals).
- *Application of knowledge* to provide solutions to practical problems (applied research).
- *Socialization*, i.e., the imparting of values and habits and cultivation of life patterns for a future role in society.

Recently there have been serious questions raised concerning fellowship and training programs and whether or not funds for this purpose should be reduced. This question will be dealt with more extensively elsewhere but we wish to note here the very close connection between training and research. The output of new knowledge by a university is directly related to the caliber and number of its graduate students. The graduate student learns by doing research. Much of the actual bench work is done by graduate students and these young minds generate many of the best ideas. If fellowships and the training programs are curtailed, the resulting decrease in the number of graduate students can have severe effects on research and the flow of new knowledge.

The Role of Basic Research in University Teaching—Research in universities provides the competence and enthusiasm that make teaching live. It brings interest to undergraduate lecturing and in and of itself contributes the core of teaching in graduate school. "Research is itself the most effective form of teaching, problem-solving which emphasizes rediscovery is next best, and teaching, for all its defects, is better today than it ever was in the past." (Personal communication from F. H. Westheimer, excerpt from talk entitled "Basic Research: Its Functions and Its Future", delivered at annual meeting of the American Chemical Society, Atlantic City, September 11, 1968.)

Enthusiasm for research as the best initiation to learning rests upon an understanding of the objectives of education. One cannot decide whether teaching is good or bad until he defines his terms, until he establishes his value judgments. One set of value judgments has been offered by James Killian, Chairman of the MIT Corporation, who wrote that:

> "The purpose of teaching in the modern university is not merely to fill the student's mind with known facts, theories, and modes of thought, it is also, and more important, to stimulate him to teach himself, to learn by teaching others, to think creatively, to want to seek answers to questions as yet unexplored, and to learn the arts of doing so."

If one accepts the setting and solving of problems as a prime educational objective, it is hard to reject Killian's conclusion that:

> "I know of no better way to do this than to give [the student] the opportunity to work with and under faculty members who themselves are engaged in seeking answers, and who can, in consequence, impart a sense of intellectual adventure." (J. R. Killian, Atlantic Monthly, Volume 53, December 1965, p. 54.)

One cannot hope to offer every student the opportunity to carry out original research for that would be too expensive in both time and money. But much of what is offered students can be presented in problem form, so that they can participate in the excitement of rediscovery. Teaching of this sort is most likely to come from faculty who solve problems themselves, or have once done so

and therefore know what the process is like. Ideally, all teachers should be researchers, or have done research.

> "When one considers the impact of faculty research on teaching, one must begin by realizing that research and teaching are not separate functions; they are closely related for the teaching of all students, and for graduate students the functions are essentially identical. Graduate student research is carried out on the apprentice system. It is the core of the advanced teaching program. It shows the student, through a detailed and specific example, the excitement of answering new questions. Best of all, it provides lessons in seeking new problems; the goal of each investigator should be setting the most difficult problem he is capable of solving." (Personal communication from F. H. Westheimer, excerpt from talk entitled "Basic Research: Its Functions and Its Future", delivered at annual meeting of the American Chemical Society, Atlantic City, September 11, 1968.)

Interdependency of Biomedical Research and Medical Education—The biomedical research effort is inextricably linked with the process of medical education and training. It is essential that the education of the physician take place in an environment of scholarly inquiry and problem-solving. The future physician will enter a problem-solving profession in which few patients will oblige him by presenting an illness following immutable rules. During the lifetime of a physician, medicine is bound to evolve along increasingly complex scientific lines. A skilled physician must be thoroughly competent in both the information of science and in the scientific method itself. Such an education requires a faculty that is active in research, teaching, and clinical care. An institution can attract, develop, and retain an expert clinical faculty only if it can provide the opportunity to engage in research as an end in itself to advance knowledge, as a means of contributing to the solution of urgent problems of disease, and as a mechanism for providing working models of the scientific method of problem solving. The totality of this effort provides an educational experience for the physician whose responsibilities will require thoughtful and skillful application of scientific knowledge and methods to real and distressing health problems.

The coupling of medical research and education in the United States has produced a unique group of scientists who are not physicians themselves but have been trained for professional careers in the whole spectrum of science related to the practice of medicine. Nowhere else has there been such a careful nurturing of the growth of this scientific cadre, uniquely qualified to complement the physician and to play a highly creative role in new therapeutic methods. It is in their hands, rather than in the physician's, that we must continue to place the prime responsibility for basic research that provides the first stepping stones in any new understanding of disease processes. It is this group whose future is so particularly threatened by current fiscal stringencies and retrenchments. They are the physiologists and anatomists, the microbiologists and biochemists, the biophysicists and pharmacologists, without whose participation the enterprise of medical education and advances in therapy would be impaired immeasurably.

The time has long gone when the physician at the bedside could hope to pursue with needed insight all phases of laboratory research that must accompany his every therapeutic need. Medical research demands total professional dedication. It is not carried out as an alternate or substitute for time spent directly in patient care. The physician and basic scientist have been most carefully coupled in the training of the medical student.

The enlargement of existing medical schools, the establishment of new schools, and the replacement of faculty have been estimated to require the education of more than 1,000 academic physicians and scientists per year through at least 1980. A significant fraction of these, perhaps 20 percent, will require combined medical and scientific training. An increased output of medical teachers and researchers is a prerequisite to maintenance of present standards of medical education in existing and new schools, and such standards are essential if we are to continue to produce highly qualified physicians equipped to utilize effectively the scientific advances of their lifetimes. As new patterns of organization of health care delivery evolve, as greater numbers of new categories of less extensively trained support personnel enter the health field to assist a physician, it becomes even more essential that the physician of tomorrow, as the leader of a "health care team," be a broadly educated, scientifically knowledgeable man.

Role of Federal Government in Support of Biomedical Research and Education

The answer to the question of why there should be support of research, particularly basic research, by the Federal Government rests primarily on utilitarian arguments. First, new scientific knowledge is an essential input to activities which the Federal Government has taken on as its responsibility, for example, national defense, health, and space exploration. Thus, the Federal Government, having embarked on improving national health, becomes responsible for providing the resources needed for new basic biological knowledge on which improvements in public health rest. Second, government support of basic research relates to responsibilities to other parts of the society. First among them is economic growth. The development of new technology is financed primarily by industry which in turn expects to benefit from the new products and thus recover the costs of research and development. New scientific knowledge, however, is a public good which is freely available to all. A business firm operating on market motivation cannot possibly pay for an adequate amount of basic scientific research although all firms and, through them, the whole economy, benefit from more scientific knowledge; thus, there is a compelling case for federal support of basic research for the general economy and welfare.

The coupling of research and education discussed above has its financial counterpart. Most professors in a medical school teach and do research. In many cases, part of his salary (related to the time he spends in research or research training) comes from an NIH research or training grant. Forty-eight percent of medical faculty members receive a portion of their salary from such grants and 16 percent receive their entire salary from such grants. *Cutbacks of dollar support, plus inflation and the resultant increases of salary scale, have placed severe strains upon medical schools and their ability to support faculty.*

It is to be noted that the direct relation between the NIH granting mechanisms and salaries for faculty members received serious attention from the members of the Administration Panel of the Wooldridge Committee ("Biomedical Science and Its Administration," a study of the National Institutes of Health, the White House, February 1965, p. 48 and 103). We have adapted one of their suggestions and *recommend that a mechanism be developed to enable academic medical centers to receive funds for payment of faculty, whether for research or for education, as a single institutional grant based on an appropriate formula reflecting the size of federally supported programs within the institution and hence the institution's response to federal initiatives and missions.* The substitution of this type of arrangement for the present system of adding the salaries of investigators to each grant, project by project, would go far toward maintaining stability despite the unanticipated program changes generated by variable and unpredictable budgetary restrictions such as those of the past four years.

A serious downward trend in research support is now in progress. Compared with FY 1967, in 1970 both effective and absolute total dollar support have declined, such that the reduction in effort or capability over this period has been of the order of 20% or more. The 1971 research grant budget will support about 9,400 research projects compared with 10,975 in 1969. In 1971, the NIH fellowship and training grant budget will support 14,231 full time equivalent students compared with 17,789 in 1969.

It takes years to construct a building that can be destroyed by a wrecker's ball in a few days. It often takes years to recruit and train top-notch research teams. These, too, can be dissolved in a comparatively short time, but it will take years to reassemble them. Furthermore, we can ill afford to curtail research training efforts. Scientifically trained manpower is a national resource. We have stated the need for an increased number of Ph.D. scientists and research-oriented physicians as future faculty members. It takes several years of postdoctoral training to produce a competent surgeon. It also takes several years of research training to produce a competent faculty member.

Research Training Programs, Research Fellowships, and Research Career Development Awards

At least four types of support for graduate education presently exist: training grants, national fellowships, research grants by way of employment of graduate students and research assistants, and university fellowships or assistantships.

Training Programs—Grants for training programs provide funds for stipends and tuition to

the student and, in addition, funds for salaries of faculty, equipment, and supplies. They are made to the staff of a department and are specifically designed to support training in research. *Training grants have become a major source of support of basic science departments.* The external review provided by the project site visit and the review by the committee evaluating the applications for a training grant have provided national standards for graduate training.

The training grant is also a major source of support in the clinical departments of the academic medical center. Here it supports chiefly post-doctoral fellows who will become the physician-scientists of the future. In other instances it supports the training of clinical specialists in areas of manpower scarcity, such as neurology and psychiatry. The training grant has been an important vehicle in developing research and new clinical competence in specialized clinical areas such as endocrinology, for example. In addition to spending the predominant amount of their time in research training, the endocrinology trainees also serve as consultants in connection with patients with complex clinical problems involving the endocrine system. To develop competence as clinical endocrinologists and to obtain patients for their studies, these trainees operate special endocrine clinics (such as a Diabetes, Thyroid, or Kidney Stone Clinic) under faculty direction, and thus indirectly provide a large amount of patient care and service. One or more of the involved faculty members is supported in part with salary money derived from the training grant in proportion to the amount of time devoted to supervision of research training. The grant also provides some money for supplies and equipment for the use of trainees. In many instances, studies conducted by the trainees also provide highly specialized diagnostic procedures for which patients with complicated endocrinological problems are commonly referred to academic medical centers. Such services cannot be provided by the financing of Medicare and Medicaid because *these programs have no capacity to create the expert capabilities required to render complex services.*

Research Fellowships—An application for a training grant program is made by the institution. Application for a research fellowship is made by an individual who has been accepted for training by a department of an institution. Predoctoral fellowships are available to graduate students in basic science departments but not to candidates for dental, medical, or veterinary degrees. Postdoctoral research fellowships are made available to Ph. D.'s and M.D.'s for advanced research training. These fellowships may be supplementary to research training programs in instances in which departments can train more men than can be funded from the training grant itself. They also support men in advanced training in departments in which a training grant may not exist, or even in government agencies including the National Institutes of Health in circumstances in which intramural funds are not available.

The fellowship program of NIH expanded less rapidly than the training grant program. The annual number of fellows grew to a little more than 1,000 in fiscal 1962, and remained at under 2,000 through fiscal year 1967. Recently NIH decided to terminate its predoctoral fellowship program. This act and the cutbacks by NASA, AEC, and NSF raised the question for prospective students whether or not science really has a high priority in this country and whether they should pursue it as a profession. The cutback in the fellowship program is particularly difficult for those departments that do not have grants for training programs and it is virtually disastrous at a time when training programs and research grants are being curtailed. This problem is dealt with further under "Effects of Termination of Training Support."

Research Career Development Awards—An institution may apply for salary support for a young faculty member who has demonstrated unusual competence and promise in research and who needs a number of additional years for maximal development of his research creativity and potential. Such an award enables him to devote nearly all of his time to research and research training under guidance of a more senior faculty sponsor, while also engaging in teaching and, in the case of an M.D., in a limited amount of clinical work so as to maintain and develop his full range of medical skills.

Various combinations of support from training grants, direct fellowships, and research career development awards, have provided substantial stability and flexibility in the development of highly competent young investigators in both pre-clinical and clinical sciences. These men have provided an uncommon source of faculty strength within the medical school at a time when the fruits of the

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biomedical science effort are beginning to have a substantial influence upon the understanding of disease and the scientific base of medical education.

Some Estimates of Future Needs of Biomedical Scientists and Teachers—Bioscience graduates provide research workers for universities, colleges, institutes, agency laboratories, and industry. They also provide teaching faculty for colleges, universities and medical school departments. The exact number of Ph. D.'s in biomedical sciences needed in research and teaching during the next twenty years is not known. If research grant monies are to remain at a plateau it may not be desirable to train an ever-increasing number of Ph. D.'s to conduct biomedical research in universities and colleges, but the need for scientists as research workers in agency laboratories, institutes and, in particular, industry, is not likely to diminish. The implication that we are training a surplus of biomedical Ph. D.'s appears unfounded, at least to the panel. All but 1.3 percent of these Ph. D.'s graduating in 1968 and 1969 found positions in which they are appropriately utilizing their graduate education, although not all of them have found the type of position to which they originally aspired. Information regarding the fate of biomedical Ph. D.'s graduating in 1970 will not be available until early in 1971.

In 1967 and again in 1968, the Medical Scientist Training Committee of the National Institute of General Medical Sciences (NIGMS) made estimates of current and future faculty needs of medical schools taking into consideration the turnover of faculty by retirement, the probable increase of numbers of medical students and house officers in existing schools, and the establishment of new medical schools as projected through 1985. These estimates called for the production of 1,000 to 2,000 new faculty members per year for the next ten to twenty years. It was projected that about one-third of these would need to be specially trained as research scientists in basic and clinical sciences and that, in addition, perhaps 20 percent of the M.D. faculty members would require substantial dual training in a basic science discipline. (These figures do not include the requirements of Ph. D. scientists who will find places outside of the academic medical centers in both basic research and mission-oriented research and development.) A shortage of faculty causes inflation; witness the "market price" of academic anesthesiologists and radiologists compared with faculty in other clinical departments. Figure 3 shows the budgeted unfilled faculty positions in American medical schools, year by year through 1969.

Effects of Termination of Training Support and Fellowship Program—During the past five years, training support from NIGMS and the categorical institutes has leveled off. In addition, fellowship support from other sources, such as NSF, AEC, and NASA, has decreased. The loss of a training grant can have a serious impact on a department, far beyond the reduction in output of Ph. D. scientists or physician scientists. In both preclinical and clinical departments the training grant provides not only stipends for post-doctoral trainees, but also salaries for faculty and money for supplies and equipment involved in training. In addition, a research training program in a clinical department provides expertise for student and house staff training and manpower for the operation of the specialty clinics in which a large amount of clinical care as well as training takes place.

There are now no alternative sources of support that can be utilized to replace the training grant or fellowship or Research Career Development Award. Strong basic science departments and clinical units can disintegrate in a short time when training grants and fellowships are withdrawn. It is an illusion to believe that the funds for training and fellowships can be siphoned from research grants. At present, research grants are being used to support graduate assistants at nearly their full capacity. Furthermore, research grants are also being curtailed and are being forced to absorb the increased cost of operation resulting from inflation.

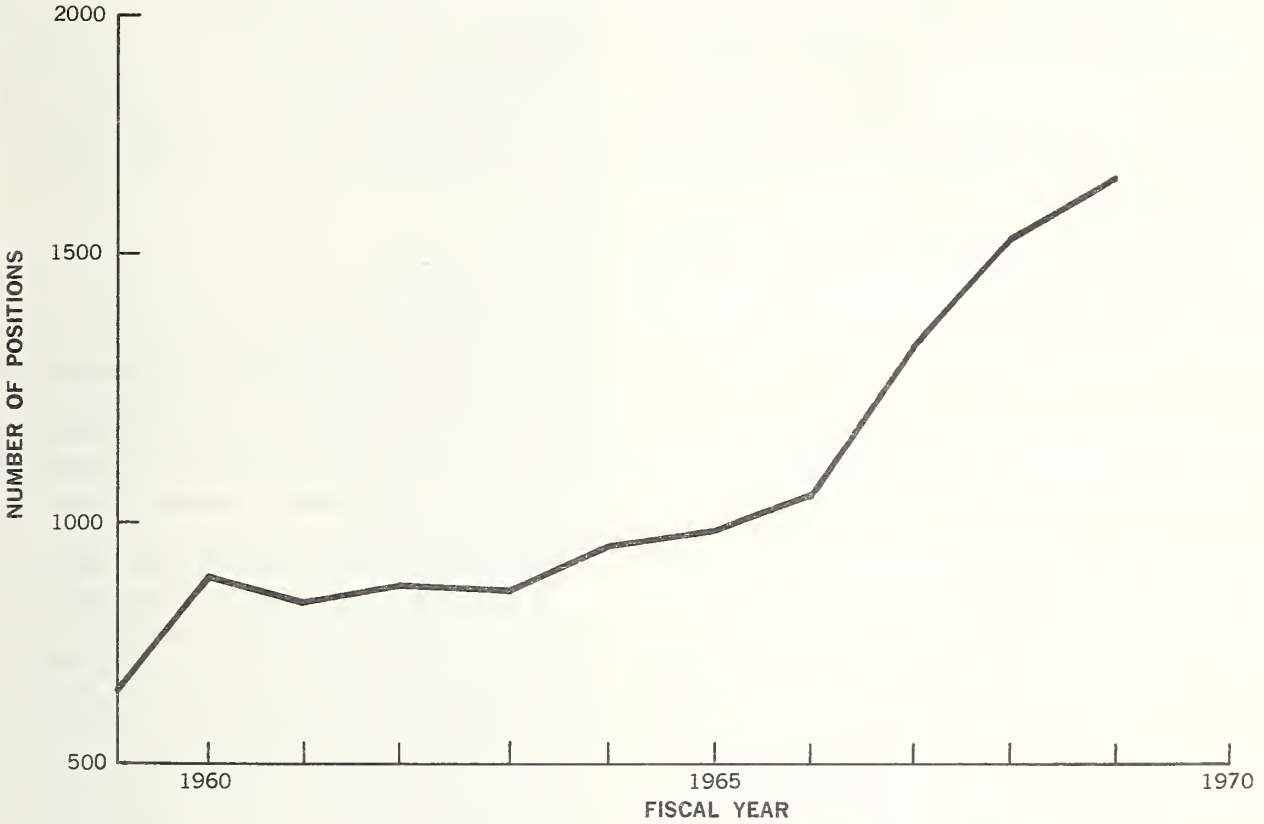
John Walsh states in Science (Volume 168, 1970, p. 1561) "It should be possible with better planning to minimize damage done in a period of budget contraction but, unless policy makers come squarely to grips with problems posed by cuts such as those in graduate support, they are likely to find themselves locking the lab door after the researchers are gone."

The impact of fellowship curtailment in the clinical departments affects not only research, but also the care of patients. Many patients who are the beneficiaries of the highly specialized services rendered by trainees are medically indigent or

Figure 3

BUDGETED UNFILLED MEDICAL SCHOOL FACULTY POSITIONS

(Source: Association of American Medical Colleges)



near-indigent, and only a fraction of them are covered by Medicaid and Medicare programs. Hospitals are already incurring large deficits from the care of such patients due to the low level of reimbursement for services provided. Clearly, additional charges to patients will not substitute for training grants either. There is no alternative source of support and withdrawal of training funds can only result in the loss of academic and clinical expertise in the medical centers and curtailment of highly specialized diagnostic services to patients. These disruptions will affect the very institutions that provide the most complicated and highly specialized care to patients who have been referred to them for such care because of the lack of appropriate facilities and expertise in the local community.

About 40 percent of the acute care beds and 80 percent of the residents in specialty training in this country are found in academic medical centers and their affiliated hospitals.

Clinical Research Centers

Since 1960 the NIH has funded the costs of construction and operation of clinical research centers in hospitals to permit studies on patients. These units promote the development of new knowledge about disease, and of new modalities of therapy. Accomplishments include discovery and elucidation of new diseases, new observations in old diseases, development of new clinical tests for evaluation of organ functions, and new therapeutic approaches in many disorders.

Following a recent cutback of funding and termination of support of 10 of the "less productive" clinical research centers, there now remain 80 centers in operation. Virtually all of these have been constricted in scope by funding restrictions and by reduction in number of beds supportable due to a relatively fixed budget and escalating hospital labor costs.

In a very real sense, the clinical research center is the culmination of long and arduous effort, and

the site at which basic and applied research accomplishments are finally brought to the patient in carefully controlled, competently supervised experimental application. Those projects that yield successful results expand the capacity of the medical profession to deliver high-quality care to the American people. Notable advances in treatment of common diseases, such as hypertension, diabetes, and cancer have emanated from the clinical research centers.

It appears particularly urgent that support of productive clinical research units be maintained with appropriate annual increments (currently 14 percent per year) to cover escalating costs for personnel and supplies.

Potential Consequences of Declining Federal Support of Biomedical Science

If support of research and research training is permitted to decline, or even if it is simply eroded by inflation, responsible agencies will be confronted with a difficult choice:

- If quality standards are to be maintained, only the best research performed by the most competent investigators can be supported. Then, if current trends continue, within a few years the research funds will again be limited to relatively small groups of institutions and great regions of the country will be without a university or medical school having a significant research endeavor. Health care in these regions will suffer and so will the education of the students.
- If, on the other hand, as funds decline, support of all projects is cut proportionately, research productivity in all institutions will be seriously impaired.

It is our view that neither alternative is acceptable. The health of the American people requires that our students be educated in settings of very high quality. We owe it to posterity to pursue research into the nature of life, of man, and of human disorders, with all the imagination and tools at our command. This may appear expensive in total expenditure, but how expensive is it to a nation that consumes tobacco, alcohol, cosmetics, automobiles, television sets, and outboard motors on an unprecedented scale?

It is a responsibility of government to promote the general welfare and to develop our national resources. The continued support of research, both basic and applied, and of research training, promotes both the general welfare and the development of our nation's human resources. *A break in any link of this chain threatens ultimately the prospect of improvement of the quality of education of physicians and care of the American people.*

Level of Support

The support of biomedical research should be consistent. Nothing is so disastrous for the conduct of a scientific enterprise as erratic changes in the level of financial support. Dr. Caryl P. Haskins recently made a strong case for the establishment of a stable minimum base of support for research. He wrote in part:

> "The development of a scientific enterprise of real consequence is as precarious as that of a delicate plant. And to the same degree, it is an organic process. Training to real research competence involves a long, slow, and expensive growth. The participants in a new and original program in a difficult field cannot be prepared overnight, and the more original and difficult the enterprise, the more this will be true. Thus the sudden and unexpected expansion of a program, especially if it is forced by the pressing of funds upon it in the hope of attaining a specific objective, can quickly lead to lowered quality, to dilution of purpose, to waste, and ultimately, often enough to failure. And equally, of course, sudden and unexpected withdrawal of support from a healthy program can lead to disorganization, disruption, and, if the contraction be sufficiently severe, to actual inviability. Even considerable swings in *expectation* of research support can be damaging, though they may be difficult to avoid. Thus rumors of an impending cut of $100 million—20 percent—in the total funding of the National Science Foundation were widely disquieting at both federal and academic levels. There followed a rumor that the cut would be reduced to $50 million, and finally it was established at $80 million. These fluctuations had adverse effects upon morale through a wide sector of the scientific community.

"All this argues strongly for gradualism in our approaches to the federal funding of research.

"But most strongly it argues for the establishment of some stable, relatively fixed formula for determining a consistent and reliable *floor* to research expenditures from year to year. There are many criteria to aid in determining such a floor. Evidently the definition should be in terms proportionate to the growth of the economy at some level. But most important of all, it should indeed be treated as a stable *minimum* base, even in years when other demands on the national economy may be unsually great. Perhaps nothing could contribute more to stability and productiveness in this arena than a widespread knowledge and understanding of an assurance of public confidence of this kind, however modest the actual amounts involved might have to be." (*Report of the President, Carnegie Institution of Washington Yearbook*, Caryl P. Haskins, Volume 68, 1970, p. 29)

Currently, assuming that the total cost of health care in the United States is 60 billion dollars annually, the cost per capita (200 million people) is $300. It seems likely that the total costs will continue to rise because of inflation and population growth. However in the rather long run, research into health care delivery systems may lead to reductions in the projected cost per capita. We recommend as a general guideline, therefore, that during the next decade medical research and education be financed as a suitable fraction of the cost of the system, and that it be sized appropriately to the health delivery system. The level at which this support should continue seems to be the troublesome issue. We recognize, of course, that the level of any element in the federal budget cannot be guaranteed on a long-term basis since priorities for allocation of national resources can and should shift over time. We submit, however, that the pace of change in budgeting for biomedical and other scientific research should be slower than that in other categories and that adjustments, particularly adjustments downward, should extend over longer periods. Research projects typically require a number of years from initiation to the generation of useful results.

We believe that the stability of funding that is so important for biomedical research could be achieved by preparation of a three-year "indicative" federal budget extrapolated from the past and projecting anticipated rates of change in funding. *In the absence of significant new initiatives*, the *rate* of change, either up or down, should be gradual and considered in relation to its impact on universities and colleges. Such an indicative budget would contribute significantly to realism in institutional planning and to stability of effort. The projection could be updated annually and would eliminate unrealistic expectations and avoid abrupt fluctuations in support that create disruptions in the overall biomedical research effort. At least a like amount should be provided for biomedical research training and professional education.

RESEARCH IN THE HEALTH CARE SYSTEM

Scope of the Problem

On July 10, 1969, then Secretary of HEW Robert Finch issued a report, endorsed by the President, on the health of the nation's health care system:

"This Nation is faced with a breakdown in the delivery of health care unless immediate concerted action is taken by Government and the private sector. Expansion of private and public financing for health services has created a demand for services far in excess of the capacity of our health system to respond. The result is a crippling inflation in medical costs causing vast increases in Government health expenditures for little return, raising private health insurance premiums and reducing the purchasing power of the health dollar of our citizens."

Total expenditures for health services in 1955 amounted to about $17 billion. In 1965, the cost was $37 billion and in 1969 this had risen to $60 billion. By 1975, the nation will be spending nearly $100 billion on health each year. These striking increases in spending, however, have by no means resulted in equal access to or utilization of the nation's health care resources by all citizens. There remain serious omissions in coverage under present mechanisms for financing health care for the poor and disadvantaged. In addition, health insurance coverage for many members of the "affluent middle-class" is proving to be increasingly inadequate.

If these defects in coverage were eliminated immediately, however, the overall result would almost certainly be an increased escalation of cost without any concomitant appreciable improvement in availability or quality of health care simply because existing demands on the system have taxed it to the point that it is virtually unable to respond to any additional burden. The wages of health workers are also rising rapidly. For many years, hospitals were notorious for the low wages they paid aides, orderlies, and workers in such service jobs as those in hospital kitchens, laundries, and parking lots. This was long rationalized as exploitation in a good cause but changes in social perspective and in the labor market, and determined union activity, have made these tradtional policies obsolete.

Finally, continued advances in medical technology will add materially to rising costs of health care, particularly in hospitals. This requires explanation because generally the history of U.S. industry and commerce shows that technological advances and increases in wages have decreased the number of wage-earners in a given sector. In 1954, when total U.S. hospital costs came to $1.5 billion, general acute care hospitals averaged 207 employees for every 100 patients; by 1964, total costs had risen to $6 billion and employees averaged 247 per 100 patients. On the surface, then, it appears that the usual trend is reversed in the health field where technological advances and increased wages have been paralleled by an increase in the number of wage earners. Economists, particularly, take the view that hospitals, unlike the U.S. economy generally, have found it unnecessary to modify procedures, change management, and reorganize to increase productivity commensurate with technological advance, improved skills and services, and higher wages.

These advances in medical technology that should, according to unrefined economic theory, reduce the number of personnel employed by hospitals are almost invariably add-ons rather than substitutes. Renal dialysis, using the so-called artificial kidney, is a specific example of a technology that has not substituted for an existing procedure or service. In health care the *addition* of technology, rather than it substitution almost invariably means additional costs for equipment and personnel.

In one New York City voluntary hospital, for example, the actual cost in 1970 of putting a patient to bed, feeding him, and supplying routine nursing care is $67 per day. The actual cost for all services rendered (apart from professional services) averages $138 per day. Most of this increased cost represents technology (whether it be drugs, X-ray studies, electrocardiography, intensive cardiac care, radioisotopic diagnostic studies, or the "heart-lung" pump) which does not reduce jobs but increases them. A recent projection by the Bureau of Labor Statistics for New York City indicated that by 1975 the number of employees in the city's hospitals will be 183,000, an increase of 40,000 or 28% from the 143,000 employed in 1965.

There is general agreement that our health care delivery system must be massively reorganized to increase efficiency and control soaring costs. The Report of the National Advisory Commission on Health Manpower (U.S. Government Printing Office, Washington, D.C., 1967) summarized the case for reorganization:

> "Many of the serious problems discussed in this Report arise from the lack of an organizational framework for the multitude of disparate elements which provide medical care. Close cooperation and coordination among them is rare, and duplication of effort and actual conflict are all too common. Unfortunately, consumers of health care are unable to make the informed judgments required to assure an effectively operating market, and the sense of responsibility of most health professionals takes the form of concern for the individual patient rather than for society as a whole. As a result, there is limited effort to assure that resources are effectively coordinated and applied where they will be most useful.
>
> "In spite of the great complexity of modern medical care, independent practitioners and institutions continue to dominate the system. Individual practice has survived in medicine because it has features which are attractive both to the physician and to the public. We appreciate the advantages of independence but we are concerned about some of its associated disadvantages. Inadequate communication, coordination, and control links among practitioners and institutions contribute to gaps in quality and distribution, as well as to the inflation of medical costs.

"A particularly difficult and important problem is the inability of individuals to find entry points into the health care system. Despite the fact that in our Commission discussions we have devoted a considerable amount of time to the problem of access, we are not able to suggest a clear solution. Many of our recommendations will improve access by effectively increasing the time which physicians can devote to their key role in this task. Also, communities might be encouraged to place on a community health organization, or even on a single ombudsman-like individual, the responsibility for assuring access. Whatever solutions are ultimately devised, the greatly increased support now provided for comprehensive health planning should be used to hasten their development. Accordingly, we recommend that the highest priority should be given by community health councils to developing methods which will assure access to adequate health care for all those in the community they serve.

"Two approaches might be used to overcome the detrimental effects associated with the independence of practitioners and institutions. One is to improve the informal links between the two groups without affecting their basic independence of each other.

". . . Another approach is to bring the two groups together within formal organizations. The extreme application of this approach would be a national health service. However, we feel strongly that the disadvantages of this degree of organization would far outweigh the advantages.

". . . It is highly unlikely that the innovation and experimentation necessary to develop either of the two approaches outlined above will occur unless fundamental changes are made in the system of payment for medical care."

There have been many suggestions for modifying the health care system. A partial list includes:

- Changes in insurance reimbursement by both government and private agencies so that coverage will no longer promote hospitalization and higher costs.
- "Better management" of hospitals.
- Early diagnosis and prevention through ambulatory health centers or group practice clinics.
- Comprehensive prepaid health care through such arrangements as the Kaiser Foundation Health Plan or the Health Insurance Plan of Greater New York.
- Increased training and use of paramedical personnel.
- Construction of special facilities for chronically ill patients, for convalescents, and for those needing custodial care so as to relieve expensive hospital facilities of this burden.
- Sharing of facilities or actual mergers by hospitals.

Clearly, implementation of such suggestions will be complex and time consuming. There should be no illusions that it will be a minor "fix-up" operation or that things can be made right by tinkering. The process will be evolutionary, of necessity, to avoid major disruptions in services under existing organizational arrangements and, meanwhile, health costs are likely to rise inexorably.

It is highly unlikely that a single system will be appropriate and effective in all parts of a country as geographically and socially diverse as the United States.

As a panel, we cannot predict the shape of the new organizational framework for health care in this country. We can, however, emphasize *the need for careful research and study before any major program for change is recommended or launched* and the present lack of *criteria for judging the effectiveness or quality of health care* delivered under different organizational arrangements.

Health Care Research and Innovation

Current inadequacies in the delivery of health care are well appreciated. To date, however, research in this field has been small in scale, limited in scope, and unproductive of information that might serve as a basis for major alterations in the present system.

Large-scale pilot studies of the delivery of health care should be undertaken in various economic, geographic, and social settings such as crowded urban areas or sparsely populated rural regions. Funding of such pilot programs will be expensive, but in view of the huge and growing direct payments now made by the Federal Government for care under the existing inadequate system, allocations of federal funds to develop improved and more efficient care would be only prudent. Such

funding could well be derived as a research component of federal health care funds—for instance, a percentage of expenditures under Titles 18 and 19 of the Social Security Act, or some other clearly identifiable source.

Although academic medical centers might serve as initiating foci for such pilot studies, projects should have the involvement and support of community and health agencies in the area of the study, perhaps through some mechanism such as a community corporation. There should be continuing and even increased support for a current prototype, the community mental health center, to encourage development of new and more efficient models, particularly those designed to relate delivery systems for mental health to those of the broader health enterprise.

Development of Health Indicators and Criteria for the Quality of Health Care

While it is generally assumed that the quality of health care delivered by a physician is directly related to the quality of his professional education, both as an undergraduate medical student and during the postdoctoral period, few studies have been done to verify this assumption objectively. A serious obstacle to such studies is the lack of readily applicable criteria for estimating the quality of health care delivered by different physicians under the same circumstances or the same physician under different circumstances. While it will clearly be extremely difficult to develop and to apply such criteria, a major effort in this direction is warranted since the results of modifications in the medical curriculum and extent and type of postdoctoral training, the effectiveness of continuing education for physicians, and alterations in the method of practice of medicine can now be judged only in the most subjective and unsatisfactory fashion.

Peer review is conducted in most hospitals but this tends to emphasize utilization and a minimum standard and is rarely applicable to office practice. In some areas of California, County Medical Societies conduct reviews incident to reimbursement under Medicare-Medicaid but this procedure is intended merely to assure that some minimum arbitrary standard is met and does not attempt to judge degrees of quality. This is not to deprecate this type of review but such a procedure will not suffice to judge the quality or effectiveness of attempted innovations.

Similarly, planning and evaluation of systems of health care require far better measurements of the health status of population groups than now exist. There is an urgent need to develop health indicators that will be sensitive at levels far below catastrophic events such as infant mortality, death rates, hospitalizations, etc. Such indicators, moreover, should be capable of application on a timely basis and should have predictive value for the system.

In summary, if large-scale experimentation in health care is to be undertaken, we must develop the means to compare the results obtained and to judge the success or failure of the experiments.

WE RECOMMEND

1. That an objective of highest priority for federal health care programs be the elimination or mitigation of the major human diseases for which effective technologies for prevention, cure, or control do not now exist.

2. That biomedical research be recognized as a central element in federal health programs and that stable levels of fiscal support be provided for it.

The annual amount of support should be extrapolated from existing levels and projected for three years. In the absence of significant new initiatives, the rate of change in this indicative budget for biomedical research, either up or down, should be gradual and considered in relation to its impact on universities and colleges.

The biomedical research support mechanisms of NIH, NIMH, NSF, AEC, and DOD which include project grants, program project grants, and contracts have demonstrated their effectiveness and should be continued.

3. That a stable base be established for support of research training programs and fellowships at both predoctoral and postdoctoral levels, adequate to assure an uninterrupted flow of research and teaching manpower for both basic and clinical science. The level of support should be established on the basis of the most precise estimates possible of the present and future needs for both Ph. D. and M.D. scientists for research and teaching in colleges, universities, research institutes, government agencies, and industry. The activities sup-

ported by training grants involve a large amount of patient care, and further reduction of support will have effects on American medicine far beyond limiting the output of research scientists. Therefore, federal support for research training programs and fellowships should be maintained at least at the FY 1969 level with adjustments for inflation, until a thorough analytic study can be made of the direct and indirect, immediate and long term, consequences of alteration of the present levels and mechanisms of support for research training programs and fellowships. If such an analysis results in a decision to reduce the number of graduate students and post-doctoral fellows, such a reduction should be coupled with the creation of alternate mechanisms of specific support for trainees, faculty, and for highly specialized diagnostic and therapeutic services to the extent that the study shows they are necessary.

4. That the importance of basic biomedical research in mission-oriented federal agencies, such as HEW, VA, AEC, DOD, and NASA, continue to be recognized and emphasized and that the agencies be given a clear and continuing mandate to engage in and support such research.

5. That when an area of undifferentiated research has progressed to the point that it appears possible to focus the work, support for the "targeted" phase of the research program by expansion of contract programs of NIH or NIMH should be derived from appropriation of new funds rather than from a trade-off against ongoing programs of basic project research or research training.

6. That a mechanism be developed to enable academic medical centers to receive funds for payment of faculty, whether for research or for education, as a single institutional grant based on an appropriate formula reflecting the size of federally supported programs within the institution and hence the institution's response to federal initiatives and missions. The substitution of this type of arrangement for the present system of adding the salaries of investigators to each grant, project by project, would go far toward maintaining stability despite the unanticipated program changes generated by the variable and unpredictable budgetary restrictions such as those of the past four years.

7. That support of research into the causes, prevention, and control of mental illness be expanded and in particular that programs of support for research into growing problems of a "medical-social" character (such as addiction and alcoholism) be developed and funded in accordance with their increasing importance in our society.

8. That large-scale projects for research and innovation in the delivery of health care be undertaken with federal funding, and that such projects be designed to permit critical comparison and evaluation of alternative systems with regard to effectiveness, efficiency, and public and professional acceptability.

9. That the National Center for Health Services Research and Development, working with appropriate organizations in and out of Government, survey present criteria for measuring the quality of health care delivered by individual physicians, and conduct and support studies for the development of additional criteria to be applied more generally to medical practice, and that the National Center for Health Statistics extend its efforts in the development of health indicators. These activities should be accorded highest priority in the two agencies and resources to support them should be allocated accordingly.

Delivery of Health Services

INTRODUCTION

Organization of Medical Practice

Delivery of health care in the United States has changed slowly during the past century. During the last 35 years it has become increasingly apparent that there is an ever-widening gap between the health needs of the American people and the ability of the health care system to meet them. This trend has been aggravated by major shifts in population from rural areas to the cities and from the central cities to the suburbs.

The system today, with modest exceptions, remains essentially fee-for-service, with a 1:1 relation between the patient and the physician in the private practice of medicine. The physician, brought up in the tradition of caring for patients who come to him with complaints and symptoms of disease, is not commonly concerned with the maintenance of the health of a defined segment of the population. To do the latter requires reorganization of the health care system, changes in the methods of payment, and modification of medical education to include this concern.

In times past, especially in small-town America, when most doctors were general practitioners who cared for the physical and mental ills and uncertainties of family groups over periods of many years, and when the physician knew the personal and family history at first-hand, he could practice the preventive medicine of the day, feeble as it was. Under the best circumstances there were few barriers to access to a physician who knew the patient and who was concerned in a comprehensive way with his needs and how they related to family and community.

Such a picture of the family doctor in the early decades of this century is idealized, and in particular bears no relation to health care of the urban poor, although undoubtedly it did apply in many small communities. The image of this "golden age" persists today in the nostalgic wish to return to the era of the family doctor, to the solo general practitioner who can take charge of the well-being of the patient and his family. The image persists not only in the mind of the public accustomed to seeing the good and all-knowing doctor in sentimentalized novels, movies, and television shows, but it has also powerfully affected the curriculum of medical schools even up to the present.

In a period when little was known about the etiology or scientific therapy of disease, the general practitioner could function reasonably well by treating the patient symptomatically, by supporting his morale and that of his family, and by observing the injunction "First do no harm." People didn't expect miracles: they knew that tuberculosis and lobar pneumonia were dreadful diseases with high mortality rates; they knew there was little that one could do about childhood killers—and, in the prevailing spirit of fatalism toward those natural calamities, they accepted them in the knowledge that their physician was doing all that could be done.

Although care of the individual and his family by a personal physician may have occurred fairly generally in small-town America, it has never been the rule in our large cities which have always had large numbers of poor and badly cared for people. *There has always been a crisis in medical care in the big cities.* The change in recent times is simply that there is much greater awareness on the part of the medical profession that medical care is grossly inadequate, and equally important, greater awareness on the part of the poor themselves coupled with growing expectation and demand for improvement.

The poor, whether rural or urban, by and large, never have had adequate access to private physicians, to the family doctors who took care of the middle class. The poor have for many years thronged the impersonal outpatient and emergency clinics of our municipal and voluntary hospitals because those were the only places to which they could go for medical care.

Doctors prided themselves on providing a great deal of free care to the poor in hospital clinics and in dispensaries—and most of those who worked there damned the system and its inadequacies. But what the individual physician or his professional organizations could do to effect better and more humane medical care has always been limited because good care is expensive and requires a high degree of organization for effective delivery. In addition, because of lack of appropriate mechanisms of paying for comprehensive care and for controlling its costs, there has been little possibility of devising and manning a more effective system.

During the past decade, there has been a growing tendency for government and the public to look to our university medical centers to take the lead in improving health care generally. It is known to all segments of the American public that the medical centers provide the highest quality of hospital care. Their professional and material resources are great and they are the source of medical manpower and new knowledge. However, historically they have been concerned mainly with in-patient care and not designed to deliver comprehensive medical services to the surrounding communities.

It is not generally recognized that personnel within these centers are more than fully occupied in their missions of teaching, research, and hospital service, and that with existing constraints of personnel and money little can be done by them significantly to extend their service commitments into the community without sacrifice of other essential activities. The extent of their service load at present is already great because *about 40 percent of acute hospital care in the United States is carried out in university hospitals or affiliated hospitals.*

However, even if the necessary resources could be provided to university medical centers, it is debatable whether in their present form they are appropriate institutions to organize and deliver comprehensive health services to the community, in particular to the urban and rural poor. The current demand for direct involvement in the immediate community (in addition to the need to provide leadership on a national scale, to conduct research over the whole range of health problems, and to educate the needed manpower for the future) tends to ignore the areas in which medical schools have been most effective and would force them into areas of responsibility outside their present competence.

The complaint is widespread that education in medical schools is restricted to study of only that segment of patients who are so sick as to require hospitalization, and that no attention is paid to the much larger number of patients who are not sick enough to be in hospitals. The traditional analogy is that hospitals see only the tip of the iceberg of disease and that most of it is submerged in the communities in which medical centers exist, but for which they take little responsibility. This figure of speech is reasonably descriptive in terms of the number of people who are in need of medical care. On the other hand, it must be remembered that the characteristics of the diseases represented by the visible and submerged parts of the iceberg are very different and, therefore, must be approached differently.

Most patients or potential patients want to have someone, preferably a physician, to whom they can bring their health problems and who will take continuing responsibility for helping them. They want a personal or family physician. They don't like the impersonality and discontinuity of busy out-patient clinics attached to general hospitals. They don't like the seemingly interminable waiting for attention, they don't like the impersonal referral to a specialty clinic where the same cycle of waiting and referral is liable to recur, and they don't like spending long hours on poor public transportation to reach the medical care they fear is going to be inadequate for their needs.

It seems clear that if significant improvement is to be made in these serious inadequacies in health care for a very large proportion of our population, there must be a fundamental overhaul of the system. Such a reorganization is unlikely to take place unless there emerges a general social awareness of the need and provision of the financial resources to meet it. Although university medical centers would like to take part in improving health care in their communities, they are almost universally hampered by uncertainty about what

their role should be and by financial restrictions. A few small experiments have been started in recent years but evidence of continued viability of those experiments in existence or of significant new starts is not encouraging.

It is not at all clear that health care will be improved dramatically by a massive increase in the number of physicians graduating from our schools unless the health care system is restructured. It has been proposed that the United States requires a doubling of the output of physicians by 1985. This estimate is based on the premise that for the indefinite future medical care will be provided in the same way that it has been in the past.

On the other side of the coin is the demonstration in England and Wales and in Sweden that despite fewer physicians per 100,000 of population, their health status as measured by mortality rates over the whole age span is distinctly superior to that of the United States (U.S. 153 physicians per 100,000; England and Wales, 122; Sweden, 117). Although there are many differences between these European countries and the United States, nonetheless these figures indicate that the health status of a population is not directly proportional to the number of physicians serving it.

What are the alternatives to producing more physicians trained to be solo general practitioners who will go out into the communities to practice medicine in the traditional 1:1 mode? This traditional approach is not likely to be successful in overcoming the defects in the delivery of health services or in improving the distribution of physicians. Moreover, this approach will be very costly in terms of educating greatly increased numbers of doctors and in paying for their services. Such a plan must be considered as tending to increase the costs in a health care system that is already suffering from uncontrolled inflation.

A general reorganization of the system of delivering and paying for health care and for the training of a variety of auxiliary health personnel such as public health nurses, visiting nurses, midwives, physicians' assistants, and family health workers should be undertaken before a commitment is made to double the output of physicians, as has been proposed. We have suggested a more modest increase for the immediate future.

How might our health care system be reorganized? The needed improvements in health care are unlikely to come about unless provision is made for the organization and operation of large-scale experiments and demonstrations. In addition, there is an increasing awareness that the reorganization of medical practice is not likely to come to pass unless the method of payment is changed from the almost universal fee-for-service system to some form of prepaid insurance on a national scale.

The cost of the improved health care that can be predicted under a scheme of universal health insurance is likely to be less than the present uncontrolled costs which aggregate more than $60 billion per annum (6.5 percent of the Gross National Product or approximately $250 per capita per year). This estimate of lower costs is based on the British experience under the National Health Service where the costs amount to about 4.5 percent of GNP, and the Kaiser-Permanente scheme where the costs average about $400 per year for a subscriber with two or more dependents.

In designing an improved health care system in the United States a cardinal principle is that it should be regionalized as conceived in the legislation establishing the Regional Medical Programs and the Partnership for Health. The problems are too vast and diversified for central direction and management.

If universal entitlement were to be enacted tomorrow, the health care system could not respond to it effectively and chaos would result instead. The groups that constitute our health care system would be well advised to begin planning now for what is likely to come about within a few years. Unfortunately, funds have not been available to plan and carry out the necessary large-scale experiments. Such funds are urgently needed so that experience can be gained in the various kinds of programs that are likely to be needed.

The University Medical Center as the Hub of a Network

One plan of reorganization envisions the university medical center as the hub of a regional network that would include a series of community hospitals and clinics and associated solo or group medical practices. The medical center would continue to carry out its present functions of education, research, and service, serving as the ultimate point of referral for diagnosis and therapy. Its relation to community hospitals would include as-

sistance in staffing, consultation, education, and quality control. The associated community hospitals would have full-time chiefs of service since they are necessary for the training of interns and residents, for the continuing education of physicians, and for quality control of practice of the physicians associated with them.

Physicians associated with the community hospitals would conduct their practice in physical proximity to the hospital to permit ready access to diagnostic procedures and easy referral of patients for specialty care. Such a close relationship to a community hospital would mean that physicians need not organize themselves into independent group practices in order to be able to provide the expensive diagnostic and therapeutic services that are generally not available to the individual physician in solo practice.

Depending upon the nature of the community being served, a variable amount of ambulatory clinic facilities away from the hospital itself but staffed by the hospital would be needed. The need for outlying clinics would be governed by the characteristics of the population being served and the availability of low cost, efficient transportation. Increased use of auxiliary health personnel would contribute greatly to the efficiency of such outlying clinics, would reduce the requirement for physicians, and would actively promote better health care for the population through education, better coverage with preventive measures such as immunization against infectious diseases, case finding, early diagnosis and referral, and improved home care.

The success of such a scheme, based on a university hospital as the regional center with satellite community hospitals, doctors' offices and clinics, depends upon good ambulatory care, both preventive and therapeutic. With effective ambulatory care the total costs can be held down and more efficient use can be made of hospital beds.

Expansion of the functions and responsibilities of university medical centers as the foci of regional systems of medical care is in line with their developing role in modern times, most recently spurred by legislation establishing Regional Medical Programs. However, sufficient funds have not been made available under this legislation, under the Partnership for Health or other legislation, to permit the development of essential large-scale demonstrations including mechanisms for utilizing auxiliary health personnel.

Comprehensive Health Plans that are not Based on a Medical Center

Institutions not affiliated with a medical school have already proved themselves capable of organizing medical practice on a large scale and of providing good care at a cost considerably lower than that prevailing in the country generally. The largest and most successful example of such an organization is the Kaiser-Permanente Foundation which operates in California, Oregon, Washington State, Hawaii, and more recently in Ohio. The Group Health Insurance plan in Washington, D.C., and the Health Insurance Plan in New York City are other examples. The Kaiser-Permanente plan provides comprehensive care on a prepaid basis to nearly two million people. Through emphasis on good inpatient and ambulatory care, it has been able to reduce the rate of hospitalization and the duration of hospital stay. These accomplishments have made it possible to lower significantly the total cost of medical care and at the same time have enabled the plan to remain solvent and to finance the construction of new facilities by borrowing in the commercial money market. At the present time, the Kaiser-Permanente plan offers the best demonstration that the costs of good medical care can be significantly reduced. (For a discussion of the Kaiser-Permanente plan see "Report of the National Advisory Commission on Health Manpower", Volume II, U.S. Government Printing Office, Washington, D.C., 1967, pp. 197–228.)

Independent Health Service Corporations

University medical centers have been reluctant to engage in the direct provision of comprehensive medical services to their surrounding communities. Their emphasis has been on the hospital services necessary to support their missions of education and research. They are not equipped with the physical resources, the manpower, and the experience needed for the delivery of community care. In addition, the lack of assured funding for community medical services has precluded serious planning on the part of most medical centers to undertake these responsibilities.

Exceptions to this statement are to be found in the participation of medical schools in the operation of Neighborhood Health Centers of the Office of Economic Opportunity and their counter-

parts in the Department of Health, Education, and Welfare. In general, however, these services have been provided for only one segment of the population, namely the poor and medically indigent, and have been concerned mainly with ambulatory services.

Although the Neighborhood Health Centers have encountered many problems of organization, management, and authority, a good deal has been learned from them about the problems of providing health care for the poor. The current trend toward the formation of independent health service corporations to operate the Neighborhood Health Centers is a result of these experiences. The contribution of the university medical center to health corporations would appear to be in line with its traditional competence, namely the provision of professional and technical consultation and assistance in organizing and operating the health services, and the education, training, and recruitment of personnel. Teaching and research in the community and its health center are necessary not only to provide the necessary trained people but also to permit improvement of the range and quality of services as new knowledge is acquired.

The financing of health service corporations presents many difficulties, not only in the provision of physical facilities and the extensive start-up costs, but also in payment of the costs of delivering health care. The sums provided by the Office of Economic Opportunity legislation coupled with Medicaid and Medicare are not sufficient. Even if national health insurance with universal entitlement were to come about and the costs of care put on an assured, prepaid basis, the serious financial problem of creating the institutions and capitalizing them would still remain.

Direct Operation of Health Facilities by Federal Agencies

The Federal Government operates directly the hospitals of the Veterans Administration, the medical activities of the Armed Services, and the Public Health Service hospitals which have responsibility for care of merchant seamen and for Indians and Eskimos.

The medical departments of the Armed Services are responsible for the care of more than three million people in the military services and for more than twice that number of dependents. In all, this system provides care for approximately ten million people at an annual cost of approximately $706 million.

The Veterans Administration, through its 165 hospitals, provides inpatient care to 195,000 veterans with service related disabilities and 581,000 whose disabilities are not service related. In 1969 its expenditures for medical care were budgeted at $1.45 billion.

The Public Health Service operates nine hospitals and thirty out-patient clinics. It spent $72 million in 1969.

The costs in 1969 for the operation of these three separate government-operated health care systems amounted to approximately $2.2 billion, or 3.5% of total national expenditures for health care.

It has been suggested that these government financed and operated health care systems might be used to carry out large-scale experiments and demonstrations under controlled circumstances that would be useful in planning the reorganization of the total health care system of the United States. On the other hand, the special nature of their patient responsibilities and their central control, financing, and direction make it unlikely that the results would have general applicability. It seems more probable, if universal entitlement to comprehensive health care comes into being, that the Veterans Administration hospital system and that of the Public Health Service might merge into the national system. Because of their unique role in national defense the military medical services should remain separate from a national system although all means should be explored to reduce the burden to the Armed Services of health care for military dependents.

PHYSICIAN MANPOWER

Introduction

A major feature of the national health crisis is the problem of physician manpower. Many difficulties hinder our efforts to provide the nation with an adequate number of competent physicians effectively distributed to meet health care needs. Planning for this goal raises such questions as what is an adequate number, what is an optimal distribution, what types of physicians are needed and, finally, who should pay the costs? The growing realization that the existing system for the

delivery of health care in the United States is long overdue for reorganization makes it more difficult to answer these questions. If the patterns for this reorganization were more clearly delineated, planning for future physician requirements would be less complex. The lag phase of eight to ten years for education and training in the production of physicians further complicates the issue because it prevents today's planning from having a major impact on the medical care system before a decade in the future. Despite, and because of, all these problems and complexities the questions related to physician manpower require serious and immediate consideration.

Number of Physicians Available and Estimate of Future Needs

Recently available figures indicate that there are approximately 300,000 professionally active physicians in the United States. This pool reflects a dynamic equilibrium between those retiring or dying each year and an annual addition of new physicians. The additions come from two sources: the physicians graduated from medical schools in this country and those graduated from foreign medical schools. The number of American medical school graduates has slowly risen in recent years and is now approaching 10,000 per year. The rate of annual increment in medical school graduates approximates the rate of increase in population growth, but does not exceed it. Supplementing the 10,000 graduates per year are approximately 2,000 physicians per year who are graduates of foreign medical schools and licensed to practice medicine in the USA. In 1968–69 there were 18,547 foreign medical graduates in training programs in this country. These physicians have been the subject of much discussion and debate. In general, they are here because of special considerations in the immigration regulations and because of the attractive opportunities to practice medicine here. Relatively few come to receive training and then return to their native countries. They must pass the examination of the Educational Council for Foreign Medical Graduates to become interns or resident physicians in hospitals and to meet the examination requirements of a state to obtain a license to practice, but it is commonly felt that these examinations alone do not guarantee that these physicians meet the standards generally applied in American schools. Many believe that it is undesirable for us to remain so heavily dependent upon foreign institutions for such a significant proportion of our medical practitioners and others point out that America should be a source of medical talent and education, rather than a recipient.

There is a widespread opinion that this country has too few physicians. Although several groups have estimated our deficit of physicians, no figure is recent or entirely convincing. The one most widely quoted, a deficit of 50,000 physicians, was made approximately five years ago. It was based primarily on an evaluation of the physician/population ratio in the northeastern section of the United States. The principal assumption was that since other geographic areas exhibited lower ratios, 50,000 additional physicians were needed to bring the national ratio up to the northeastern section standards. Other estimates were based on such factors as the time required for the performance of various duties by the physician, and ranged from "no deficit" to a deficit of 100,000 or 150,000.

The estimates of deficit can be based either on calculations of medical need or on evaluation of future demand. Predictions based on *medical need* are confounded because:

- Physician-to-population ratios in the United States already exceed by far those in a number of other countries conceded to have better health care and those of large health care systems in the United States which deliver excellent care in organized, non-traditional ways.
- Experience to date suggests that in the absence of a modified and improved system for providing such care, an additional number of physicians will only aggravate the geographic and socio-economic imbalance of health care which already exists and will engender even greater overall costs, both by their fees and by the expense of the procedures which they perform or initiate.

Predictions based upon *demand* indicate no presently detectable limit except the ability to pay. This applies not only to the demand for physicians' services, but also the demand by qualified students for places in medical schools.

Other factors affecting *both* need and demand include:

- Anticipated population increase.
- Increasing dependence upon foreign medical graduates for physician manpower.

- Further sophistication in medicine and a corresponding increase in the requirements for professional competence of physicians.
- Diversification of need for physicians in such activities as research, administration, teaching, environmental control programs, and occupational and industrial health programs.

It is our conclusion that the output of existing medical schools should be increased by 25 percent by the year 1975. As the population grows, new medical schools should be established according to regional needs, but this will not be a rapid or inexpensive means of sharply increasing the output of physicians.

The suggested 25 percent increase in the production of physicians, or approximately 2500 per year, is based on the following considerations:

(a) We should eliminate our reliance upon the graduates of foreign medical schools, which at present account for about 20 percent of newly licensed physicians.

(b) We should produce physicians at a faster rate to match the rate of population growth. Although the number of new physicians in the United States today is increasing slightly faster than the population, this includes foreign medical school graduates. The rate of increase in physicians graduating from American medical schools per se does not exceed the rate of increase in the population.

(c) We believe that our existing educational system can manage a 25 percent expansion in medical school graduates by 1975. To accomplish this, the number of admissions must be increased by 25 percent no later than the fall of 1971, since it requires four years for most schools to train a physician, even without an internship. If our present standards of medical education are to be maintained and the output of physicians is to increase beyond 25 percent, an increase in the number of schools or a fundamental revision of medical education, or both, will be needed, Since either of these will require several years, increases significantly beyond the 25 percent level cannot be realistically expected before the latter years of this decade.

(d) Acceleration in the rate of production of medical school graduates would be possible only if an adequate number of qualified applicants were available. Currently in the United States there are about 30,000 applicants per year for entrance into medical schools and about 10,000 are accepted. The qualifications of the rejected applicants are not clearly documented, but most medical educators believe that within this pool there are at least several thousand potentially satisfactory medical students, and that if it were known that more places were available, additional individuals might apply. This situation would clearly permit a 25 percent increase in acceptance rate and perhaps slightly more. If acceleration were at a much greater rate, the number of applicants might become a limiting factor.

The Distribution of Physicians

A contributing factor to the present crisis is that physicians tend to settle in attractive regions of urban and suburban areas and this results in a deficiency of physicians in rural and disadvantaged urban areas. The mere addition to the number of physicians is not likely to correct this maldistribution and might even intensify it because the new physicians would probably continue to go to the attractive areas.

Many factors determine a physician's location of his practice. The modern doctor tends to go where medical support facilities are adequate. Family considerations such as housing, schools, recreation and other facilities are, of course, important.

Various programs have been designed to influence the distribution of physicians. Some states have offered support for medical education in exchange for a period of guaranteed service, but with little success. The day when a physician tended to locate his office over the corner drugstore in a small community appears to be past. Today the practice of medicine demands laboratory and x-ray facilities that can be obtained only in a hospital or sizable community health center. Attractions of this nature will influence greatly the distribution of physicians. It is unlikely in the United States that direct assignment of physicians to a specified geographical area will be accepted.

We believe that community planning of hospital and health service facilities, combined with the modern use of transportation of patients, will be the most successful method of the future to attract physicians to a particular geographic area. It does not appear that indentured service will offer a major solution to the distribution of physicians.

Type of Practitioner

During the past several decades, the nature of medical practice in the United States changed markedly. The number of specialists increased significantly and the number of general practitioners declined (85% of practicing physicians were general practitioners in 1934, 45% in 1960, and 37% in 1965). Although the trend toward specialization produced many benefits, a widely held opinion maintains that the loss of general practitioners has created a problem in the delivery of health services. Is the rise of specialization an inevitable consequence of the broadening of the scope of medical knowledge and activities? Can a general practitioner survive in the modern state of medical knowledge? These questions are related to and, indeed, are a major part of the determination of the medical care system of the future.

The concept is much more complex than a simple delineation of general practitioner and specialist. Specialization varies substantially. The so-called specialty areas of internal medicine, pediatrics and psychiatry, are broad in concept and are hardly specialties in the narrow sense when compared with orthopedic surgery or neurosurgery. Physicians in the broad specialties of medicine serve in a major way as primary, or first contact, physicians, who see the patient at the onset of his illness. In the opinion of the panel, physicians in these broad specialties of medicine will become the primary physicians of the future, and the production of this type of physician should be accelerated. However, some of the more narrow specialties may already be overabundantly staffed with physicians.

The Millis Commission of the American Medical Association (*The Graduate Education of Physicians*, Report of the Citizens Commission on Graduate Medical Education, 1967) has examined these problems and recommended the production of a specific new type of general physician whom they called the "primary physician" to fulfill the role of the general practitioner of the past. Such an individual would not perform major surgery but would care for medical and pediatric problems, carry out some types of minor surgery, gynecology, obstetrics, and a limited amount of psychiatry.

This concept has received wide attention and publicity and, in some quarters, especially in the government, the Millis pattern has been accepted as the solution to this phase of the manpower problem. We do not agree. It is unrealistic to think that a single individual can master the broad range of knowledge needed to employ modern medical technology to the fullest advantage. This is the main reason for medical specialization and nothing indicates that new medical graduates will be attracted to the "primary physician" form of practice any more than they have been to general practice in recent years.

Several facts are clear. The past concept of an isolated family physician's office as the standard for primary medical care is not compatible with modern medicine. Today's physician needs ready and almost immediate access to laboratory, radiologic, and other sophisticated facilities if he is to deliver high quality care. The grouping of physicians' offices around a community or regional hospital is one logical and desirable outgrowth of this requirement. Paramedically-staffed health stations located in small and distant communities could be established and modern transportation could be made available so that distance alone would become a lesser problem. With the clustering of physicians about the community hospital, interdisciplinary consultations would be immediately available. In a medical sense, this would be a "group practice" of the various types of physician *specialists* with close interrelationship in the referral of medical problems but not necessarily a financial or legal integration. Under such an arrangement, the need or demand for the general practitioner would be highly questionable. General internists and the general pediatrician would serve as the predominant initial contact physician and would refer even relatively simple problems of obstetrics, surgery, and other sub-specialty areas to appropriate specialists immediately at hand.

We believe that a growing proportion of medical school graduates will continue to enter one of the current disciplines of medicine, such as pediatrics or internal medicine. Such physicians are qualified to fulfill the role of the "primary" or "first contact" physician through hospital medical centers, neighborhood centers, group practice, or closely related practice arrangements utilizing modern transportation to provide readily available medical care. In the final analysis, the type of practice is chosen by the medical graduate, and not by the school and, in fact, specialization usually occurs during the post-M.D. training, not during the pre-M.D. period.

In our estimation the need for emphasis on the production of a large corps of "primary physicians" has not been demonstrated at this time and it is unrealistic to make this a major goal of medical education. It is, therefore, the opinion of this panel that *current government planning and financial support for medical education should not imply an obligation or commitment to the production of a specific type of general physician* such as that described by Millis and his colleagues. Research into methods for delivery of health care and for the utilization of different types of physicians and other health professionals should be encouraged. In attacking the complex problems of reorganization of our health care delivery system, we must avoid the mistake of seizing on attractive panaceas such as the concept of the "primary physician" in the absence of evidence of effectiveness or relevance.

Methods of Education

It has been suggested repeatedly in regard to medical education that the length of the training period be shortened and that it be carried out more economically with less capital investment. The presently accredited medical schools in the United States have, in recent years, produced a product with considerable quality control. The second phase of the development of a physician, the years spent in intern, residency, and fellowship programs, has been less well controlled. The mechanism of specialty board certification, recently supplemented by a similar procedure in family practice, has served to some degree as a quality control mechanism. These methods, developed during the last several decades, have been generally accepted as a major step forward from the uncontrolled apprentice type of medical education used in the early part of this century. It would be most unfortunate to return to such a system. This does not mean, however, that there is no room for improvement and cost reduction in our present methods. Indeed, today a major number of medical schools are accepting applicants with less than four full years of premedical school training in colleges and universities. Furthermore, many medical schools are introducing programs providing for graduation in three years rather than the conventional four years. There is a strong movement to combine the classic internship program with that of residency and fellowship training. The reduction in the time required for the education of a physician will produce an increment in the number of physicians during the year of the change only. The long-range impact on the pool of physicians is that it provides a younger graduate with more years of foreseeable service and that it is also less expensive.

Can additional changes be made in the medical education process which will maintain the high quality of medical education, but will also produce physicians more economically? Several considerations are involved:

Preclinical training—An effective program of medical education should still include a strong basic science background as a preparation for clinical medicine, biomedical research, or teaching. Many students now enter medical school with a far stronger science preparation than in former times. The need for extensive preclinical laboratory courses has diminished. It is because of the better science background of entering students and the development of "core" curricula that some shortening of the time spent in preclinical courses has taken place in most medical schools. It should be possible, therefore, for preclinical departments to educate more students without expanding their total space requirements significantly and without a parallel increase in cost per student.

Clinical training—We are not aware of an acceptable substitute in the clinical years for the highly personalized case method of instruction carried out in an atmosphere of research. Habits of inquiry must be developed in the student of medicine since continual learning is a necessity for the physician throughout his lifetime.

Although some proposals suggest that the clinical education of the students in expanded medical schools could be carried out most economically by practicing physicians in community hospitals, the panel believes that the performance of such a critical and formative educational function exclusively in an environment lacking full-time teachers and research programs would be highly undesirable. Such a change might possibly result in a return to the generally discredited mode of clinical apprenticeship of former times. Although such a system offers the attractions of reducing the capital and operating expenses required for a university medical center and of permitting the use of the numerous community hospitals for a larger output of

medical graduates, it represents a serious reversal in the quality control of medical education. The education of the physician is more than a trade school operation simply involving instruction in the medicine of today. It is a scholarly academic process designed not only to create an individual who has the capabilities for today, but also to develop a physician with the desire and ability to be a self-motivated scholar of the medicine of tomorrow. This has been one of the major contributions of the contemporary university medical center during the past twenty years. To a large degree, it would be lost if we were to return to the apprentice system of the past.

Post M.D. Education

Currently almost all medical school graduates spend one year as an intern and a majority spend two or more years as a resident physician. Although attempts are being made to shorten and unify this phase in the education of a modern physician, it is an indispensible step in the completion of training for the family physician, the broad specialist, or the narrowly focused specialist. This phase of training requires faculty time and funds to pay for such time, just as undergraduate education does. Further, recent increases in post M.D. training-study stipends from extremely low to moderately high levels, have added another financial burden to the medical centers. The problem is complicated because individuals in this portion of their training are in part students and in part contributors of vital services to the hospitals and medical schools as physicians and teachers. This area of medical training has received much less attention than the pre-M.D. period, but it is equally important and necessary and is more than a simple apprenticeship with a practicing physician. *We believe that greater attention should be given to the design of programs for post-M.D. education and that increased support should be made available for the faculty time and trainee stipends required for this important component of the training of a physician.* The granting of the M.D. degree does not produce a physician ready for the practice of medicine.

The Use of Auxiliary Health Personnel

In the United States, we have relied traditionally on the physician as the provider of all phases of health care and have not made systematic or maximum use of auxiliary health personnel to extend the capabilities of the physician, especially in the delivery of primary health services. There is strong evidence that the increase in productivity of physicians which has occurred in this country during the past two decades may be attributed largely to the use of ancillary personnel. This indicates that more extensive use of existing and new classes of auxiliary personnel would permit more effective and efficient use of a scarce resource, namely the skills of the physician, in the direct care of patients.

Many technical assistants in medicine now perform highly specialized functions, especially in hospitals, and many programs exist for their training. The categories include a variety of laboratory technicians, radiological technicians and therapists, specialists in rehabilitation and physiotherapy techniques, medical social workers, and many others.

Many of the functions now assigned to the physician in the delivery of primary health care could be assumed by a new class of auxiliaries who may generally be classified as physicians' assistants. Depending upon their training, physicians' assistants might perform as generalists or be specialized to varying degrees. The term is used to indicate that as a class they are dependent upon and supportive of the physician's role and are not operating as independent professionals. Physicians' assistants, such as nurse-midwives, pediatric assistants, child health associates, and psychiatric counsellors, must be made available in adequate numbers, and the conditions of their education, certification, and employment must be appropriately defined. Their availability would undoubtedly improve the access to and quality of medical care and the cost would in all likelihood be less than if the functions delegated to them were carried out by the physician himself. Moreover, their use should reduce the presently perceived need to educate a larger number of physicians.

While the foregoing is probably correct, it should not be assumed that physicians' assistants, in the short run of five to ten years, could take up all of the slack in the delivery of health services. To produce the number needed, which might approximate the number of physicians currently in training, major programs will have to be inaugurated. The training programs for physicians' assistants should be kept under the supervision of academic

medical centers, at least until the educational requirements of this newly emerging class of health care auxiliaries have been clearly defined. Such an arrangement would enable physicians and their assistants to learn to work together during their training. At this early stage in the development of programs to train physicians' assistants, the evidence points strongly to a high degree of acceptance of them by both physicians and patients.

Training programs are likely to be of two kinds: those in which a certificate is granted after training periods that may be as short as a few months or as long as two years; and programs leading to a bachelor's degree after four years of study. Whether the training period leads to a certificate or a degree is dependent upon the student's background.

In either type of program the costs for the clinical part of the training will not differ significantly from the costs of educating medical students. The training period for physicians' assistants is much shorter, however, so that the total cost is correspondingly lower.

Although the education of a considerable number of these new kinds of health care personnel would be desirable, this is not likely to come about unless their role in health care is defined legally and unless the Federal Government gives extensive support to academic medical centers to provide such training. It is important that government support be provided not only for degree programs but also for those in which a certificate is awarded. The latter programs are designed to utilize the talents and training of the large pool of medical corpsmen who leave the Armed Forces each year after completion of their military service. At the present time few of these well-motivated men find their way into the civilian health care system because very few training programs exist and career patterns have not been established.

SUPPORT OF EDUCATION FOR HEALTH PROFESSIONALS

Introduction

While it is recognized that our health delivery system will undergo considerable change in the next decade because of rising health expectations coupled with advancing health knowledge and technology, it is also apparent that whatever its form and economic base, major expansion of health manpower, both in quantity and variety, will be required. The physician will remain a key figure in the health delivery system but his role will continue to be modified and diversified, and increasingly will be supplemented by the roles of a number of non-physician health professionals. In response to this challenge, the objective of health professional education should be to provide manpower for health care units of varying size with combined expertise to meet the varying needs and conditions for health care. This requires more effective recruitment of personnel, more flexible curricula, and enlarged educational facilities. The costs will be considerable, and present a legitimate charge against the future benefits of improved health care. The investment should be primarily in existing or new university medical centers since only these embody the combination of teaching, research, and health care required to provide leadership for health professional education. A large portion of the investment will have to be made by the Federal Government, although state, private and individual investment should be encouraged as well.

Despite the increased need, medical education (as an example of most health professional education) is in the throes of a major financial crisis. This is emphasized by the fact that to enable them to remain in operation during 1970–71, 47 schools of medicine will be receiving emergency financial assistance through the Health Professionals Educational Assistance Special Project Grants Program. The crisis has been caused in large part by a combination of: (i) expansion of predoctoral education of physicians to meet national needs and to more adequately represent within the profession the socio-economic diversity of the population; (ii) reliance on indirect support of medical education through research grants during a period of reduced growth of support for such research; (iii) lack of proportionate growth of private support of medical education; (iv) general inflation; and (v) lack of a clearly defined federal policy and of an accompanying financial commitment for support of health professional education.

Historical Perspective

More than fifty years ago, the Flexner report stimulated fundamental and far-reaching modifications in medical education (*Medical Educa-*

tion in the United States and Canada, Flexner, Abraham, Bulletin No. 4, Carnegie Foundation for the Advancement of Teaching, New York, 1910). Medical schools began to change almost overnight from diploma mills and trade schools to academic centers of excellence. Before 1915, most medical education included little scientific content. Most teaching involved lectures and apprenticeships. Both teachers and students were largely ignorant of contemporary advances in biomedical science. Almost any student who wished to study medicine and could afford the fees was admitted to a medical school. After completion of the prescribed courses of instruction and payment of his fees, he was given a medical degree. At that time, the reputation of American medicine left much to be desired. Those who wanted a better education than was available in the United States went to Europe for training if they could afford to do so.

Three major immediate results of the Flexner report were: diploma mills and medical schools established primarily for the financial profit of their staff were abolished; basic medical science and a scientific approach to clinical medicine were incorporated into the curricula of all approved medical schools; and a system of full-time faculty was introduced, and has grown ever since.

American medical education and medical science rapidly surpassed comparable systems elsewhere, and their superiority was recognized internationally by the time the U.S. entered World War II. The unparalleled growth of science and technology, integral to the war effort, was reflected in American medicine. Federal support for research in biology and medicine led to discoveries, the scope and significance of which far surpassed anything previously achieved. Their practical application resulted in prevention of millions of premature deaths from acute infectious diseases and in marked shortening of hundreds of millions of disease episodes, and provided knowledge with which it is now possible for the physician to intervene effectively in almost every conceivable disease to the great benefit of Americans and, indeed, people throughout the world.

Another result of the Flexner report was a limitation of class size in medical schools through emphasis on laboratory-based and tutorial instruction. Construction costs of basic science facilities and shortage of qualified instructors served as checks on enrollments.

The nature of students admitted to the study of medicine also changed. Some measure of affluence had always been necessary for the study of medicine. Tuition and living costs, compounded by the need to forego remunerative employment for several years, effectively limited medical education to students drawn from upper and upper-middle socio-economic class families.

Students going to college during and immediately after World War II had become much more interested in science and technology, and in their applicability to medicine. The G.I. Bill and similar programs administered by various states removed some of the financial obstacles to extended periods of study and income deferment. Suddenly, there were four or more applicants for every available space, and some medical schools reported twenty applicants for every opening.

Then came *Sputnik*. Again, the pattern changed very rapidly. Career and financial incentives were offered to students in a national effort to overcome the perceived shortage of trained scientists and engineers. No such incentives were offered to students aiming at careers in medicine. Applications to medical schools declined concurrently. The application to acceptance ratios in 1960 were approximately 1.7 to 1. Three points deserve emphasis.

(1) The number of spaces available in medical schools rose only slightly between 1940 and 1960.

(2) The American population increased by almost 40 million in the same period of time.

(3) An average graduate student in the sciences received $2,800 yearly in non-refundable aid (scholarships and fellowships). An average medical student received less than $500.

The declining numbers of applicants to medical schools, growth of the American population, increasing needs for specialists to cope with the greater complexity of medical science and technology, and rising purchasing power and expectations of the American people for health care brought about the following developments in the early 1960's:

(1) The American Medical Association and other private and public agencies launched intensive recruiting efforts to attract young people into medicine.

(2) More than a dozen new medical schools were built, and older schools enlarged, to raise

entering class size from approximately 6,000 students yearly in 1960, to almost 10,000 yearly in 1970.

(3) The very small sums of money available through institutional sources for financial assistance to medical students were first augmented by foundation support, and then significantly increased through federal assistance programs.

Current Situation

In summary:

(1) Approximately 30,000 students make approximately 150,000 applications for approximately 10,000 places in the entering classes of American medical schools, and there is an annual applicant increment of 10% to 15%.

(2) Experts agree that the intellectual capabilities of medical school applicants are greater than ever before, that their scientific preparation is better, and that they represent one of the most outstanding segments of the student population as judged by intellect, motivation and personal attainments.

(3) The great majority of medical students come from well-to-do families (Figure 4) though it is increasingly recognized that the medical school community should include significant representation from rural, minority and lower socio-economic backgrounds. This is needed not only to equalize opportunities but also to bring to bear new experiential and informational expertise on undergraduate and postdoctoral medical education, and to define approaches to meet the health care crisis in urban ghetto and rural areas.

It can be stated unequivocally that the single most important impediment to recruitment and retention of students from minority and lower middle class backgrounds is the lack of financial assistance for such students (Report of the Association of American Medical Colleges Task Force to the Inter-Association Committee on Expanding Educational Opportunities in Medicine for Blacks and and Other Minority Students, April 22, 1970, p. 4). Those schools which have tried to identify potentially qualified applicants among the poorer social classes have not only found sufficient numbers to fill all available places several times over, but have encountered these financial obstacles head-on. Moreover, lack of financial assistance is increasingly becoming an impediment for students from the middle and upper middle socio-economic strata. Superficially, this group should be able to pay for medical studies. In fact, this is not the case:

(1) Their parents are often in their mid-forties. Incomes may be relatively high, but so are debts.

(2) Younger siblings may just be starting college, an added burden on the family.

(3) Medical students, over 21 years of age, are often reluctant to continue complete financial dependence on their parents.

(4) The high divorce rate, and the many broken families, provide an insecure financial base for children of a former marriage, especially if these children are over 21.

(5) The average cost to the student of a medical education is over $4,000 annually for four years, and rising rapidly. Few families can afford this level of expenditure unaided. The figure includes only basic living and tuition costs, exclusive, for example, of a car or other transport, often essential for medical students.

As a result, it is estimated that approximately ⅓ of medical students require full support, ⅓ require partial support, and ⅓ require no support—the fractions varying somewhat depending on whether a student attends a private or a publicly supported medical school in his state of residence. It should be noted that these facts obtain even though the parents of medical students are often economically more self-sufficient than average.

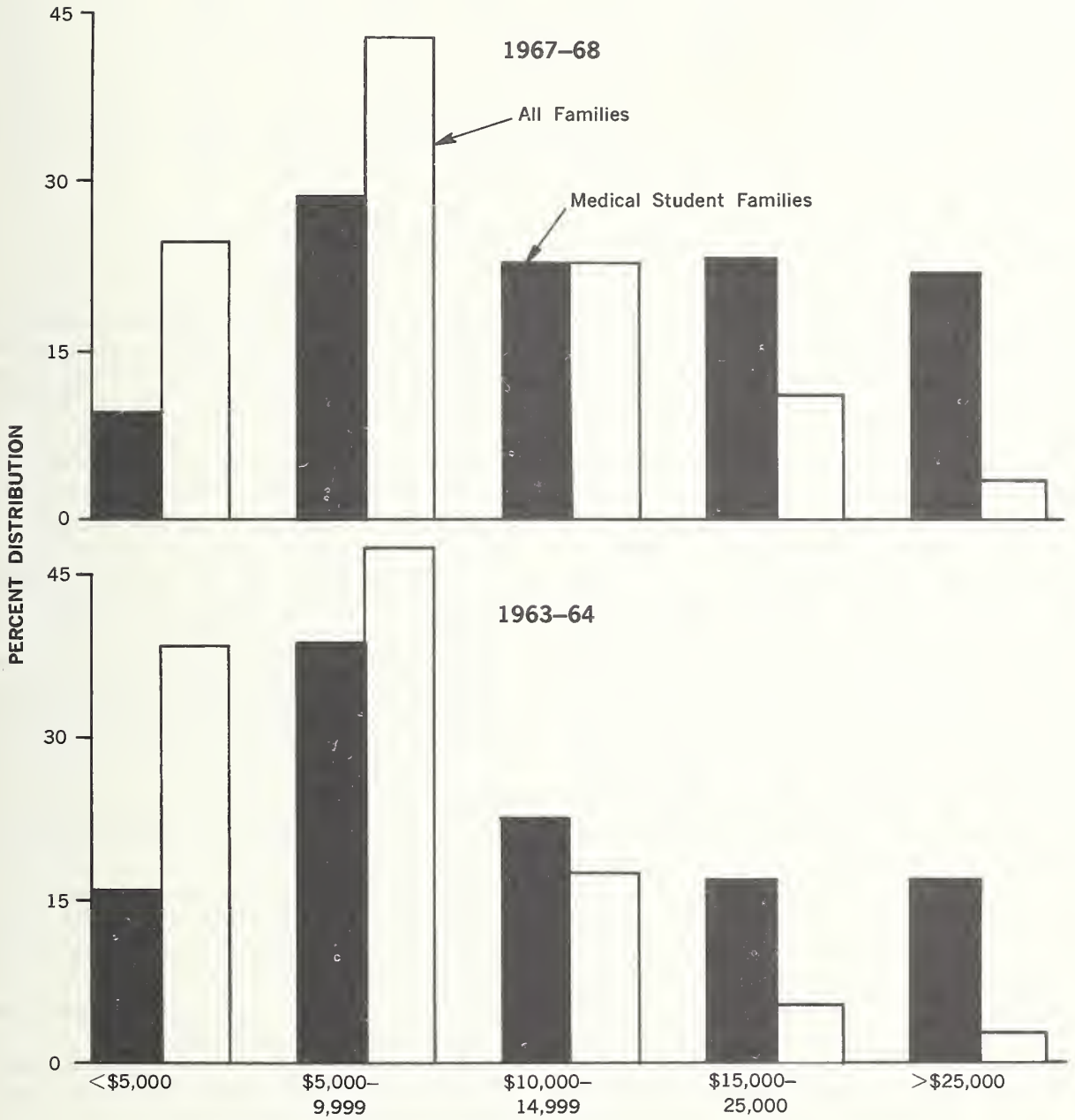
In 1963–64, 26% of medical students borrowed money to finance their education; in 1967–68, 42% borrowed—a 4% yearly increase. In 1970–71, it is estimated that 54% will borrow—understanding that this understates the case if more students are drawn from poorer families (*How Medical Students Finance Their Education*, Smith, L. C. R., and Crocker, A. R., Journal of Medical Education, Volume 46, July 1971, pp. 567–574.)

Average annual expenses of approximately 35,000 medical students enrolled in 1967–68 ranged from $3,400 for single students to $6,300 for married students with two or more children. Approximately 60% were single and 40% married. The average for all students was $4,400. Assuming a 6% annual rise in expenses, and the same general population representation among medical students, the average annual expense in 1970–71 will be $4,960 for just under 40,000 students.

The federal programs for financial assistance to medical students came at a most propitious time.

Figure 4

COMPARISON OF FAMILY INCOME OF MEDICAL STUDENTS AND OF ALL FAMILIES



Reference: How Medical Students Finance Their Education, Smith, L. C. R., and Crocker, A. R., Journal of Medical Education, Volume 46, July 1971, pp. 567–574.

Non-federal sources of scholarships and loans never sufficed for more than a fraction of the need. Banks have not been very willing to make loans on *people*, as contrasted with loans on *things*. A publicly supported program of financial aid to medical students, therefore, became essential. (See Table 1.)

If the federal scholarship and loan programs had continued to develop as initially envisaged, and in parallel with growth of enrollments, and

TABLE 1.—STUDENT AID AND ENROLLMENT—Medical Students—1963–64 to 1969–70

	1963–64	1964–65	1965–66	1966–67	1967–68	1968–69	1969–70
Total student aid (in thousands)	$14,568	$18,047	$22,041	$25,153	$28,997	$32,301	----
Scholarships (in thousands)	$3,901	$4,096	$4,512	$6,379	$8,653	$11,206	----
Loans from all sources (in thousands)	$10,667	$13,951	$17,529	$18,774	$20,344	$21,095	----
Health Professions Education Assistance Program, DHEW	----	$5,680	$9,593	$13,655	$15,075	$15,109	----
American Medical Association—Educational Research Foundation	$4,118	$4,134	$4,279	$1,947	$723	$817	----
National Defense Educational Act	$2,947	$529	$292	$421	$305	$196	----
Other	$915	$1,384	$1,736	$1,220	$2,301	$2,581	----
School	$2,687	$2,224	$1,630	$1,531	$1,939	$2,392	----
Number of Schools	87	88	88	89	94	99	----
Total Enrollment	32,001	32,428	32,835	33,423	34,528	35,833	37,756

Source: Journal American Medical Association, Education Number, November 1966 and 1969.

had institutional and other sources of financial assistance also continued along projected growth rates, the problem would merely be difficult. As it is, none of these expectations has materialized, and other factors entered the arena which herald an impending catastrophe unless effective countermeasures are taken immediately.

As the federal programs began to take effect, foundation support declined. The foundations, first to be persuaded of the needs for direct financial assistance to medical students, and first to develop model programs, saw their mission accomplished and withdrew.

Events during the past half decade have eroded public confidence in higher education and led to a lessening of the rate of growth of support for universities and students, including medical students. Personal earnings have covered 29% of the income of single students, and 20% of that of married students. A major share of this source of income has been through research fellowships and other research-related activity. This potential source of income was near its peak in 1967–68, and is rapidly declining at present.

Most importantly, the Health Professions Student Loan Program, which had provided an annual average of 80% of the amounts requested on the basis of defined needs for the past four years, suddenly was cut in half, and then provided only 36% of the requested amount in the Fiscal Year 1969–70 (Table 2). This unforeseen reduction could not have come at a worse time. Not only were more enrolled students becoming eligible for loans under the terms of the program, but broadening of the recruitment base for medical students had been initiated and was contributing to increased costs.

Difficult as it is for students from middle-class families to finance their medical education, it becomes almost impossible for members of the poorer groups. Family resources are usually nonexistent. Most families are in debt, and steady employment is less common than among upper classes. Such families also find it most difficult to dispense with the income producing powers of a young son or daughter—and thus the financial assistance needs of these students are proportionately much greater than for comparable numbers of middle-class students.

As a result of reductions in student aid programs medical schools, working within the tightest possible strictures, have had to:

(1) refuse legitimate requests for support from qualified applicants;

(2) increase the loan burden on many students above the level generally considered sound by economists and educators;

(3) warn admissions committees that their poorer students should not count on receiving all necessary support, and that few would be able to avoid loans entirely;

(4) temper plans for expansion of enrollment.

Only a handful of medical students was forced to interrupt their education for financial reasons alone in 1969–70 (Personal communication, Association of American Medical Colleges, Division of Student Affairs). Institutions used their ultimate reserves, and many students were forced to obtain bank loans, a solution only possible for those who had had previously established bank accounts in lending institutions—a situation clearly not applicable to most of the poorer students.

Based on present experience that two-thirds of students require financial assistance, it is estimated

TABLE 2.—HEALTH PROFESSIONS STUDENT LOAN PROGRAM

	Fiscal 1965	Fiscal 1966	Fiscal 1967	Fiscal 1968	Fiscal 1969	Fiscal 1970
Number of Participating Schools*	87	87	88	93	98	100
Amount Requested	$11,539,969	$11,712,356	$14,457,828	$16,884,425	$19,030,340	$22,113,875
Amount Allocated	$6,628,788	$9,834,259	$14,217,790	$14,736,357	$14,240,726	$7,924,353
Percent of Request	57.4	83.9	98.3	87.2	74.8	35.8
Number of Students Enrolled in Participating Schools	31,416	32,040	32,883	33,595	35,117	37,756
Number of Students Assisted	7,186	9,475	11,303	12,484	12,375	----------
Percentage of Students Assisted	23	30	34	37	35	----------

*Figures are for medicine only. Dentistry, osteopathy, optometry, pharmacy, podiatry, and veterinary medicine are *not* included.
Source: Division of Health Manpower Educational Services, Bureau of Health Manpower, NIH, PHS, DHEW.

that some $100 million annually is required to support the 40,000 student medical school capacity drawn from the applicant pool.

Significant enrollment increases would increase this sum proportionately. Significant recruitment from the poorer strata of society, on the other hand, would disproportionately raise this figure.

Currently available scholarships amount to approximately $10,000,000 annually. Of this amount, approximately $8,000,000 is derived from federal sources. Taking into account student summer earnings, perhaps $75 million additional is needed for student support.

The Federal Government should, directly or indirectly, see that this sum is obtained. Institutional resources cannot meet more than a small fraction of this amount, and few universities command significant unallocated resources today. Loans through the private sector are being used, but they meet only a small portion of the need because of restrictions on borrowers, high interest rates, and other limitations.

Paralleling inadequate student support in the health professions has been lack of a coherent policy for institutional support. The educational costs of medical school operations are difficult to document, primarily because the costs of education, research, and patient care are intermingled in different ways in different institutions. As a team, the faculty member, the resident physician, the intern, and the medical student all deliver patient care, the result of which frequently is excellent medical service to the public as well as the production of new physicians. The Association of American Medical Colleges is currently studying a sample of medical schools in an attempt more accurately to separate those costs ascribable to education from those of other activities and programs. In the absence of reliable information, a rough estimate of educational costs is $7500 per student per year. Tuition will average about $2000 per year in 1970 in private schools. Students in public medical schools pay an average $600 a year, which is well above what other graduate students pay. Obviously, a student's tuition meets only a small percentage of the costs of his education. In 1958–59, tuition and fees represented 14% of income for regularly operating School of Medicine programs; in 1967–68 they represented less than 10%.

The Federal Government is deeply involved in meeting a large proportion of medical school expenditures. In 1958–59, 30% of total medical school expenditures were paid for by public funds; in 1967–68 it was 53%. Yet it is essential to realize that despite the *massiveness of federal support to academic medical centers, little of it is supplied in the name of medical education itself.* For example, in 1967–68, 33% of total medical school expenditures were paid for by federal research funds (up from 23% in 1958–59). Or looked at differently in that same year, of DHEW obligations to *medical schools*, 48.6% went for research; 24.7% for training (1.4% for predoctoral training); 12.9% for teaching facilities; and 13.8% for other purposes.

The institutional and special project grants for medical schools, first authorized in 1965 under the Health Professions Education Assistance Act, will meet only on the order of 2%–4% of total medical school expenditures this fiscal year. The institutional grants are awarded on an across-the-board, per capita basis, allowing for no priorities or cost differentials among the professions. Under the same legislative authority, approved but unfunded construction projects are equal in number to those for which funds are available.

It is recognized that the major degree of federal involvement arose, in a sense inadvertently, from independent major policy decisions of the past two decades. The first decision, reflected in the preced-

ing figures, was to provide major financial impetus to biomedical research following the Second World War. This led to inextricable co-mingling of research and educational activities in the medical schools and shifting of the pattern of support for education. The second decision was to provide broadened financing for health care under Medicare and Medicaid. This considerably altered the economics of the health delivery system and simultaneously increased the need for health manpower training and altered the clinical base for medical teaching. The problems thus created cannot be solved without further federal initiative, and this must be taken with intelligent understanding of the issues involved. The fact is that American medical schools—nearly 60% federally supported—can be destroyed by abrupt withdrawal of funds and can slowly deteriorate if federal support declines without suitable substitute.

While partial responsibility for medical education was assumed as a by-product of other federal commitments, it is now recognized by most academicians and public policy analysts as having a legitimacy of its own. This stems from the character of manpower shortages; recognition of health care as a right rather than a privilege; the increase in the federal share of personal health care costs from 23% in 1950 to 35% in 1968 (and still rising); the recognition of problems of distribution of services; the high degree of nationwide mobility of health professionals; and the close linkage of manpower training to national health services delivery and research goals. Further, it is vital at this time that this responsibility be met by establishing direct funding patterns for health education to assure it equal priority with research and service functions in professional schools. It must be recognized that while costs of education are considerable, they are a legitimate and necessary charge against future benefits—both to the immediate beneficiary (student) and the long-term beneficiary (patient and society).

Mechanisms for Financing Health Professional Education

The traditional sources of support for medical schools include the following: (a) *Tuition, Endowment and Philanthropy*—these sources rarely meet a significant portion of the operational costs. There is little likelihood of a major increase in philanthropy, and tuition is already prohibitively high in most private schools. Any increase in tuition will restrict the recruitment of students to those from higher income families. (b) *Service*—many schools derive income from the clinical activities of salaried faculty. At best, these funds barely support the activities of the clinical departments concerned. It would be unsound to project major increases in these funds. (c) *State Support*—the total support by state governments to their medical schools exceeds $100 million. In addition, a few states support medical education by per capita payments to all medical schools in their state for each student enrolled. At the present time most states do not. (d) *Federal Support*—this has been the largest source of support, though little has been directed to education per se.

As noted earlier, seventeen medical schools are threatened with closure or major cutbacks in their educational programs if new funding is not made available. At the same time, many medical schools, in response to governmental and other pressures, have admitted large numbers of minority and other students from low income families for the coming year, assuming that federal scholarship and loan programs would be available for their support. Because of budgetary cutbacks these funds are not available in the expected amounts but the medical schools cannot withdraw from their obligation to train these students. To meet these critical needs, the appropriations under the DHEW Health Professions Educational Assistance Program should be immediately increased to the level of full authorizations.

Simultaneously, to avoid arbitrary limitations upon the number of physicians produced, and to permit career choices in medicine for all those who are qualified, it is important that the Federal Government take the lead in immediately developing a stable method of financing medical education which will be independent of the level of support for biomedical research and will be affected primarily by requirements for new physicians.

Programs to provide funds for health professional education should take at least two forms: direct subsidy to schools and assistance to remove economic obstacles to students seeking education in the health professions. Further, they should have at least the following general characteristics:

(1) They should be economically sound. Projected sources of revenue should equal and perhaps exceed somewhat the projected expenditures. It

would be preferable that there be no need to call upon general funds of the Federal Government for this special purpose.

(2) The sources of revenue should be variable to respond to unexpected changes in expenditure levels. At the outset, a reasonable range of revenue should be decided upon and a funding program designed which will require less than the maximum amount of revenue obtainable. This will then permit the additional revenue to be called upon if costs exceed prudent estimates.

(3) The sources of revenue should be such that they represent primarily a "user tax." It is reasonable that costs of physician education should also be considered a component of overall health care costs.

(4) During their earning years, physicians should repay any monies lent to them. There has traditionally been Congressional resistance to federal support for the education of physicians who may one day earn disproportionately large amounts of money. If physicians are required to repay part of their educational support, this should make any proposal politically more acceptable. At the same time, the terms of repayments can be such that they will not present an onerous burden to the physician at an early stage in his career.

(5) Funds for medical school operation should provide a stable base of support for the school while permitting students to exert a significant amount of economic leverage. To the extent that whoever pays the piper calls the tune, the medical school is always subject to outside pressures, with attendant good and bad effects. Therefore, it is probably best that a medical school should not become overly dependent and therefore overly influenced by a single source of funds.

(6) Special care should be taken to assure that the funding mechanisms provide a positive incentive for students of limited financial means to study medicine. This has always been necessary for students from minority groups. Today, it applies increasingly to middle-class students who frequently sever dependence upon their parents and who very early take on family obligations of their own.

In considering methods to provide funding for medical education, a basic question relates to who should be responsible for operating the funding mechanism. Because the Federal Government already pays such a large part of medical school costs, a first impulse is to urge the government to expand existing programs and/or establish some new mechanism such as a bank or trust fund. However, the heavy dependence of medical schools upon direct and variable federal funding has, in large measure, led to their present difficulties. If this dependence is to be reduced, it may be more appropriate to have non-governmental responsibility for such a program. As a panel we are not constituted to pursue in depth the political and economic issues in this question, but it is important to note them here for future consideration.

Having discussed the nature of expenditures required to support medical education and the characteristics of a feasible program to administer such funds, what are the possible sources of this support?

Traditionally, medical schools have relied upon funding from the Federal Government, primarily for research but with an increasing component for education. However, the history of past appropriations suggests that the needs for increased funding which were discussed earlier will not be met from this source.

In the search for a more stable source of support, a frequently advocated possibility has been an educational opportunity bank (for example, *A New Approach to the Financing of Medical Education*, Shell, Karl, Harvard Medical Alumni Bulletin, Vol. 43, No. 3, Winter 1969). It would lend funds to medical students which they would repay during their earning years. Refunding of the bank could be accomplished either by repayment of the loans with interest, or by taxing the professional incomes of physicians who borrowed money. The income tax would have the advantage of reducing the burden for those physicians who choose to enter less lucrative branches of medicine or government service while requiring a greater repayment from those physicians with very large professional incomes.

A second approach would be to institute a small surcharge on premiums for medical insurance, with the funds so provided placed in a trust fund to cover the costs of education. This tax could be collected from insurance carriers, including the Federal Government, rather than from individuals. Although the tax would become a part of the premium, it would not simply be a "tax on the sick"; it would involve all participating persons. Since insured health expenditures (and therefore premiums) currently amount to about $30 billion annually and are growing at 10% per year, the sur-

charge could be very small and still provide comparatively large amounts of money to the educational trust fund.

These two approaches have been modeled to show the type of analysis which needs to be done. The data can be found in the Appendix. Provision for funds to cover both institutional support and expenditures for student living costs are included. Repayment by physicians who borrow would be limited to those funds received for living expenditures, and would be proportional to the amount borrowed. Funds for institutional support would be considered to be entirely a legitimate component of health care costs, and would not be added to the base upon which physician repayment is calculated.

On analysis, it appears to us that either method by itself would be unsuccessful. The bank operation, with revenue only from repayment of loans with interest or from taxation of physicians' income, cannot meet inflation of both educational costs and financing costs (see Appendix). Unless the physician is required to repay his debts within a few years, which would constitute a pressure to establish an early and very lucrative practice, the loan repayment in devalued dollars would put the bank in debt more than $100 billion by the time the first borrowers have repaid their debts after forty years. Still, the loan program *does* meet the politically important criterion of having the physician directly assume a larger part of the burden of his educational expenses. For this reason it should not be discarded, but reinforced with funds from another source such as the "user tax" on health insurance premiums.

Preliminary studies suggest that introduction of a 1.0% tax on health insurance premiums would make a bank feasible. This assumes there will be only an 8% growth of health insurance premiums and that physicians will repay their loans through a 5% tax on their gross professional income rather than simple repayment with interest. It is worth noting that health insurance premiums have increased at 10% per year over the last decade. If the increase continues at this rate (and there is little reason to assume we shall be able suddenly to control health care costs), a considerable surplus of funds would accrue in the bank.

It thus appears that this is potentially a very fruitful avenue to explore immediately in the attempt to find a feasible, stable support for funding medical education.

WE RECOMMEND

1. That the output of existing medical schools be increased by 25% by the year 1975 and that as the population grows, new medical schools be established according to regional need.

2. That the Federal Government expand the funding of medical education by direct subsidy to schools and by provision for student aid, and that current Federal Government planning and financial support for medical education not imply an obligation or a commitment to the production of large numbers of undertrained general physicians.

3. That, in addition to expanding subsidies for medical education, the Federal Government consider establishing a stable self-sufficient system of funding medical education that would be (a) responsive to public demands for physician services, (b) reduce economic barriers to medicine as a a career, and (c) balance fluctuations in direct support. In pursuing this objective, the Federal Government should explore, together with appropriate outside agencies and educational institutions, whether an educational "opportunity bank," supported in part by physician repayment and in part by a "user tax" derived from the health care system, would be an acceptable mechanism to provide funds for medical education.

4. That federal funds be made available for extensive expansion of programs for the training of physician-dependent health care personnel, and that the Federal Government (a) take steps to define the role of physicians' assistants in the health system and to define their licensure or certification and the legal basis for their employment, and (b) draft a model law governing the training of physicians' assistants and the legal basis for their employment for consideration by the Council of State Governments.

National Health Policy

The total outlays of the Federal Government for health during FY 1971 are estimated at $20.6 billion. This will be 10.5% of all federal spending and more than 25% of total public and private direct spending for health. Such aggregate figures fail, however, to portray the variety of federal health programs and the many agencies responsible for them. The Department of Health, Education, and Welfare has the primary responsibility for programs influencing the health of the public, the Veterans Administration operates the largest hospital system in the world, the Department of Defense, of course, has large programs of biomedical research and patient care, and in all, more than twenty different departments and agencies are involved in independent programs of significant size. The diversity of these expenditures is illustrated in Table 3 in which are listed the federal outlays for health and health-related activities during FY 1970 when the total figure was $18.2 billion.

At present, no individual or group of individuals within the Executive Branch of the Federal Government has responsibility for monitoring these heterogeneous activities in the health field or for establishing national goals and priorities in relation to which the various programs can be evaluated, coordinated, or directed. Central control and evaluation consist largely of a retrospective tabulation of the sum of the many budgetary decisions to foster or to limit growth of individual programs. The absence of a formal, prospective coordinating mechanism leads to inefficiency and unnecessary duplication of programs and activities.

At this time there is no clearly stated national policy for health. The twin considerations of escalating cost and current disarray in the health field urgently require that there be such a policy. Despite a massive allocation of resources, the Federal Government has responded tentatively, partially, and episodically to the enormous problem of health care. The absence of an articulated national policy hinders the use of federal expenditures to promote long-term objectives, to husband national resources in health, and to achieve greater efficiency and economy. In addition, the absence of such a stated policy prevents the private sector from developing programs in accordance with nationally accepted goals.

The development and implementation of such a national health policy would require coordination of programs in three interrelated areas:

A. *Development of a national system which can insure that excellent medical care is available with minimum financial, social, or geographical restrictions.* As one component this may eventually require a national health insurance program. More basically, solutions are needed for problems of maldistribution and inefficiency of health care resources, including institutions, facilities, and personnel.

B. *Education of physicians and other health care professionals in the number and variety necessary for the prevention and treatment of disease.* This will require strengthening and expansion of educational institutions and removal of economic barriers to education for the qualified potential students.

C. *Research into the causes, treatment and prevention of disease.* The basic health problem lies in the continued existence of major diseases for which only partial solutions or expensive palliative measures are available. For success, programs for the development of new knowledge of disease

TABLE 3.—FEDERAL OUTLAYS FOR MEDICAL AND HEALTH-RELATED ACTIVITIES, 1970

[*By agency, in millions of dollars*]*

	Health research	Training and education	Construction	Organization and delivery	Direct Federal hospital and medical services	Indirect Federal hospital and medical services	Prevention and control of health problems	Total
Health, Education, and Welfare	1,169.2	648.3	372.5	179.3	131.6	10,225.7	464.6	13,191.2
Health Services and Mental Health	95.9	125.4	353.9	166.5	131.3	39.3	338.1	1,250.4
National Institutes of Health	949.6	480.7	9.5	2.8			6.2	1,448.8
Consumer Protection and Environmental Health	100.6	10.9	5.2				103.0	219.7
Social Security						6,850.9		6,850.9
Social and Rehabilitation Service	23.1	29.8	3.8	10.1	3	3,327.9	16.9	3,411.9
Other						9.2		9.2
Defense	104.3	132.3	63.0		1,476.8	209.8	21.5	2,007.7
VA	65.5	95.4	81.8	3.0	1,340.7	71.2		1,657.6
HUD			155.8	.4				156.2
Agriculture	42.9						163.7	206.6
AID	6.6	7.7	12.9	6.6	18.5		108.5	160.8
OEO				3.5		152.9		156.4
NASA	110.7							110.7
AEC	104.0	.6						104.6
Labor	.4	35.4			1.0	15.8	2.7	55.3
NSF	24.8	5.0						29.8
Commerce	.7	.1	9.1					9.9
Civil Service Commission						41.2		41.2
State		5.0	.1	3.8	.1	.3	21.1	30.4
Other agencies	10.4	2.2	32.3		27.5	4.9	21.4	98.7
Federal employee health benefit						259.6		259.
Total outlays for health, 1970	1,639.5	932.0	727.6	196.7	2,996.2	10,981.3	803.6	18,276.6 8

*Tabulated data derived from Table L-20 page 173. Special Analyses. Budget of the United States. Fiscal Year 1970. The data are estimates of outlays based on the proposed budget.

must merge with a sound policy for the support of all of the fundamental biological sciences.

In each of these three areas, both the public and the private sectors should interact for optimal flexibility and efficiency. To implement its health policy, however, the Federal Government should assume the final responsibility for insuring that all three components of the health care system are effectively supported and coordinated.

National health policy cannot be written overnight. There is a need for an adequately staffed organization to carry out continued policy analysis and to coordinate planning and implementation of federal health programs.

We doubt seriously that this continuing responsibility can be discharged by any single cabinet department or independent agency because so many of them have major health and health research programs as part of their mission. Furthermore, established and long standing doctrines within the existing governmental structure concerning roles, missions, and jurisdictions, make it exceedingly difficult to graft new responsibilities for planning, evaluation, and communication onto the present machinery.

We, therefore, favor assignment of responsibility for the examination of health policy issues confronting the Federal Government to a group within the Executive Office of the President. The requirement of an annual report on national health goals and programs, similar to the annual report of the Council of Economic Advisers or the Council on Environmental Quality, would be a highly effective stimulus to policy development and would help meet the needs of Congress for an understanding of the issues underlying national goals in health care, health research, and health education and of the position of the Administration in regard to these issues. The report could describe in detail the progress being made by both public and private groups.

It has been suggested that a Council of Health Advisers consisting of full-time Presidential appointees might fulfill this responsibility. We have reservations about the proliferation of specialized Advisory Councils within the structure of the Executive Office.

We propose that the structure of the Executive Office be examined and that an appropriate focus for development of health policy be delineated. A

sub-group of the Domestic Affairs Council staff could conceivably discharge this function, but the result might not be as visible as one might desire. Other possibilities would be to strengthen the Office of Science and Technology for this purpose or to establish a group that would be associated partially with the White House staff and partially with the Office of Science and Technology.

Although the proposed group in the Executive Office would not be responsible for carrying out programs, its relations to the President, to the Office of Management and Budget, to the Office of Science and Technology, to Cabinet-level officers, and to Congress could be such that its influence would be substantial.

WE RECOMMEND

That a mechanism be created in the Executive Office of the President for (a) the development of a national health policy to guide federal departments and agencies and the private sector, and (b) the preparation of an annual report on national health goals and programs.

APPENDIX

(This discussion supplements "Mechanisms for Financing Health Professional Education," page 50.)

SUPPORT FOR MEDICAL EDUCATION

In past years two different approaches have been advocated to provide a stable base for funding medical education. The first of these, *an educational opportunity bank*, would lend to medical students tuition funds which they would then repay during their earning years. Refunding of the bank could be made either by repayment of the loans with interest, or by taxing the incomes of physicians who borrowed money. The latter method would have the advantage of reducing the burden for those physicians in less lucrative branches of medicine while requiring a greater repayment from those physicians with very large incomes from medical practice.

The second approach to funding medical education would be to institute a small *surcharge on premiums for medical insurance*, with the funds so provided placed in a trust fund to cover the costs of tuition. This tax could be collected from insurance carriers, including the Federal Government, rather than from individuals. Although the tax would become a part of the premium, it would not be simply a "tax on the sick"; it would involve all participating persons. Since insured health expenditures (and therefore premiums) currently amount to $30 billion annually and are growing rapidly, the surcharge could be very small and still provide enormous amounts of money to the trust fund.

It appears to us that either method, by itself, would be unsuccessful but that a combination of the two might be made to work. The following discussion will show how we arrived at this conclusion, and will then delineate the boundaries of a combination system which we think is worth pursuing further.

Components of Our Model

In order to adequately compare the two proposals, as well as to manipulate the variables in each, we have tried to use a standard model with the following components:

Cost of medical education

Under this title we have included only costs of education per se in the first series of examples, but in the second we have included monies for living expenses during the non-earning years of medical school. For the education costs, we have used currently accepted estimates of $7,500 per student per year, and have assumed this cost will grow 7% a year from now on.

For the borrowing to meet living expenses, we have made estimates of $3,000 and $6,000 per year, the lower figure probably representing the least a student would need in a typical urban medical school location, and the upper figure the most a student would be permitted to withdraw.

Number of students requiring aid

Based on previous studies of medical student needs, we have assumed approximately 50% of entering students (5,500) will require aid in the first year of the program. Further in line with the expected growth of medical schools, we have assumed an additional 250 students per year will be added to the number of those requiring help.

Length of the loan program

Although the program would theoretically continue indefinitely, we have provided calculations through the 40th year after its inception. In this model, students would not be required to initiate payback until ten years after their first borrowing. For the usual student, this would permit four years of medical education, a year of internship, two years of military duty, and three years of residency prior to initiating repayment.

Loan service rate

We have assumed a 5% service charge on the loan during its first year. This could cover the administrative costs of setting up the loan, arranging for financing, establishing repayment schedule, etc.

Interest rates

Interest on the debt.—Although repayment by physicians and/or a surcharge on health insurance premiums will eventually bring adequate monies into the medical education trust fund, there will have to be significant borrowing in early years to get the program under way. In the following examples the interest on this borrowing is varied from 6% to 9%, although we regard 7% as a likely figure. We have further assumed that ongoing administration of the program will require roughly 2% and have included it in the debt service.

Interest during the grace period.—As noted before, we have assumed a grace period of ten years prior to a repayment of debt. In some examples we have calculated the effect of charging 5% interest during the grace period, although in most instances we have charged no interest at all for the first ten years. It can be noted here that whether or not interest is charged during the grace period makes very little difference in the overall economics of the program and, as a consequence, it is probably better to drop consideration of interest during the grace period because of the adverse psychological impact it may have on the borrowers.

Interest during payback.—For those examples in which the physicians simply repay their loans with interest we have varied this interest from 5% to 9% on the outstanding balance. The period of repayment in each case is 20 years commencing at the end of the grace period, and therefore ending 30 years after the initial loan was received.

Tax on physicians' income

In the other version of the educational opportunity bank, physicians repay the bank a fixed percentage of their income for 30 years, thus completing the payback 40 years after the initial loan. Those physicians with proportionately larger incomes would, as a consequence, contribute more to the bank than those physicians in less lucrative forms of practice. Our calculations used an average salary of $30,000 as currently reported for physicians in private practice, and we have assumed an average growth of 7% per year for the future. The examples include tax rates of 1% through 5% on this yearly income, but specifically exclude nonprofessional sources of income such as investments.

Tax on health insurance

This source of revenue would be based on the insurance premiums for both private and federally-sponsored health insurance. At the present time, these amount to approximately $30 billion per year and, like insurance premiums generally, correspond roughly with the expenditures covered by health insurance. Although health expenditures have grown more than 10% a year over the past decade, we have conservatively estimated this increase in most examples as only 8% per year, in the hope that increases in health expenditures can be brought at least partially under control. For the sake of completeness, we have also done a few runs with the increase continuing at 10% per annum.

On this growing base of $30 billion, we have tried out tax rates of 0.5% and 1.0%. These percentages were chosen because each provides some flexibility to increase the tax rate in the future without quickly encountering a politically difficult hurdle. That is, a tax rate which begins at less than 1% is likely to have a hard time breaking the 1% hurdle and, as a consequence, if a tax program is starting at less than 1%, it should be tailored to permit the start well below the 1% level to make room for future increases. Similarly, starting at a 1% level gives considerable latitude for increase prior to the next percentage hurdle.

Use of the Model to Explore Various Alternatives

Turning now to the examples themselves, the first series covers borrowing only to meet schooling expense ($7,500) for four years, and illustrates

both types of physician repayment to an education opportunity bank: straight repayment of the debt with interest over 20 years after a ten-year grace period, and repayment through a tax on physician income for 30 years after a ten-year grace period. It is immediately apparent in both cases that the system cannot be economically self-sustaining. This is due to the fact that physician repayment over 30 or 40 years cannot make up for the inflation which will occur during that time—inflation both in the costs of education and in the numbers of students requiring help—and the subsequent dilution in value of the dollars being repaid into the system. The least satisfactory is the simple repayment of debt with interest and, in the most favorable example (Table 1) where the debt service is only 6%, the outstanding debt in the year 40 has increased to $123 billion and is increasing $11 billion annually at that time. Instituting a 5% interest rate during the grace period (Table 2) merely reduces the outstanding debt to $100 billion at year 40. Even where the physician is charged 9% interest during the payback period and 5% interest during the grace period (Table 3), the outstanding debt is still $89 billion at the end of 40 years and, as before, increasing by a larger amount every year. Furthermore, in this example, the physician is required to pay $5,500 every year from year 11 through year 30. In other words, $110,000 repayment on an original loan of $33,300.

The other method of repayment to the loan fund, a tax on physicians' income, is slightly less unfavorable because the income base on which the tax is made will also grow with expected inflation. Nevertheless, with the most favorable debt service rate of 6% and a 5% surtax on physicians' income (Table 4), the outstanding debt is $84 billion at the end of 40 years and, as before, growing at an increasing rate each year. If the debt service rate is increased to 9% (Table 5), the outstanding debt is $160 billion at the end of 40 years and is increasing by $14 billion annually.

Clearly, an educational opportunity bank whose only source of income is repayment by physicians would not be economically feasible at any acceptable interest rate or taxation level.

If a new source of revenue, the tax on health insurance premiums, is introduced into the examples, the feasibility of the educational opportunity bank improves sharply. Two variables will significantly affect the amount of money to be obtained from such a tax. The first of these is the tax rate itself, and in our examples we have tried both 0.5% and 1.0% for reasons detailed earlier. The other variable is the rate at which the volume of expenditures covered by health insurance, and therefore health insurance premiums, will grow. Although this rate of growth has exceeded 10% annually during recent decades, we have used an 8% growth rate in most of our examples in the hope that health care costs can somehow be controlled. However, in those examples in which we have used a 10% growth rate, the amount of money brought into the fund from the insurance tax increases sharply.

Table 6 illustrates physicians repaying their debt with varying interest rates, but with the introduction of an insurance premium tax of 0.5% and an 8% annual growth of insurance premiums. In even the economically most favorable examples (i.e., low debt service, high interest on loan, and interest during grace period) the yearly increase in debt does not begin to drop off until more than 35 years after the program is underway, at which time the outstanding debt has already reached $8.6 billion (and will continue to rise for many more years until the yearly increase in debt finally becomes negative). Furthermore, a physician would end up paying $4,700 a year for 20 years for a total of $94,000 on an original borrowing of $33.3 thousand.

However, markedly different results are obtained if it is assumed that health expenditures and health premiums will continue to grow at 10% a year as they have over the past decades. In these examples (Tables 7, 8, and 9) under even the most economically unfavorable conditions of a 9% debt service rate, an insurance tax rate of only 0.5% will still bring the program into the black shortly after the 30th year while permitting the outstanding debt only to reach $2.2 billion at year 25. By year 40, the program would be $12 billion in the black, permitting a reduction in the insurance tax, a reduction in physician payback interest rates, or both.

The next four charts illustrate the other method of physician payback—a tax on physician incomes. With the additional insurance tax at 0.5% and the rate of growth of health expenditures back to 8% a year, the program is only marginal economically. Table 10, for example, shows that with a debt service rate of 7% and a 4% tax on physician gross income for 30 years after the ten-year grace period, the outstanding debt builds up to $10 billion by

year 35 and by year 40 is only being reduced by $322 million per year.

If, however, the tax on physician income is increased to 5%, with a 7% debt service rate (Table 11), the loan program looks fairly feasible. If the debt service is increased to 8% (Table 12) or 9% (Table 13), the program will eventually get into the black, but not until year 40, and it incurs outstanding debts beyond $7 billion in the interim period. This seems somewhat risky considering how hard it is to predict 40 years ahead. On the other hand, if health care premiums should increase by anything more than 8% a year during this time, the program would be easily successful.

Table 14 illustrates what would happen if the tax on health care premiums were increased to 1% but the rate of growth of health care expenditures were held to only 8%. At an insurance premium tax rate of 1%, the flow of funds into the educational opportunity bank is so large that too much money is accumulated in the bank no matter what the scheme of physician payback. In fact, in Table 14 we have actually eliminated any physician payback either by repayment of debt with interest or by tax on physician income. In this circumstance of no physician repayment, and even with the debt service rate at 9%, the 1% tax on health insurance premiums results in an immediate surplus of $139 million which increases to a surplus of $14 billion by year 40. To be sure, increasing costs of the program will, by year 40, result in a slowing of the increase in surplus each year. But nevertheless the program would be so far ahead that it could withstand an actual increase in debt rather than just a reduction of additional surplus. In short, with a 1% tax on health insurance premiums, there is a large surplus of funds with any reasonable combination of debt service, expected increase in costs of tuition, and number of borrowers, irrespective of whether physicians do or do not pay back.

In the second series of charts, however, the scope of the loan program is expanded to provide money for living expenses during the four years of undergraduate medical education, and the financing now requires both a 1% tax on health insurance premiums, and physician payback through a tax on professional earnings. Under the most pessimistic assumptions (students borrowing $6,000 for living yearly in addition to $7,500 for tuition, 9% interest on money borrowed to fund the program, and only 8% annual growth of health insurance premiums) a 1% tax on insurance premiums is insufficient without 5% physician income tax (Table 15) or with it (Table 16).

Assuming a 9% annual increase in health insurance premiums brings the program into the black after 40 years if the physician tax remains at 5% (Table 17). If the latter is increased to 7.5% (which would probably be viewed by medical students as onerous), the program has a large surplus by year 30 (Table 18). And if one assumes a continuation of the current 10% growth of health insurance premiums, a 5% physician tax produces a comfortable surplus by year 20.

If the interest paid by the program for the money borrowed to fund it is 7% (historically, a more likely average over 40 years), but if the health insurance premiums grow only 8%, then a 7.5% tax on physician income is necessary (Tables 19 and 20), if medical students borrow the full $6,000 for living expenses.

Finally, exploring the lower boundary of this model in which students borrow $3,000 for living expenses above $7,500 tuition, the program generates an immediate and rapidly expanding surplus when paying either 7% or 9% on money initially borrowed, even if health premiums grow only 8% and physicians' income tax remains at 5% (Tables 21 and 22).

Conclusions

On the basis of the foregoing examples, a number of conclusions appear reasonable with respect to the feasibility of an educational opportunity bank for physicians. If the bank is used to cover only costs of medical schooling:

1. The bank operation with revenue only from repayment of loans or taxation of physicians' income is not feasible.

2. Introduction of revenues from a 0.5% tax on health insurance premiums will not make the bank economically feasible if physicians are simply required to repay their loans with reasonable interest and if overall health expenditures do not increase by more than 8% per year in the next four decades. On the other hand, the 0.5% tax would suffice if health care costs continue to increase as they have in previous years.

3. Introduction of a 0.5% tax on health insurance premiums can make the bank marginally

feasible, assuming only an 8% growth of health insurance premiums, if physicians pay back through a 5% tax on their gross income. Of course, even more than with straight loan repayment, should the health insurance premiums increase at 10% per year rather than 8% per year, a 5% tax on physicians' gross income would more than suffice.

4. With a 1% tax on health insurance premiums there is an enormous surplus of funds in the bank even without any physician payback whatsoever. This applies to all rates of debt service with both an 8% as well as a 10% growth in health insurance premiums.

If the bank is used to cover both the costs of medical school and of living expense:

1. A 0.5% tax on health insurance premiums will be insufficient under any circumstances.

2. If students borrow a full $6,000 per year for living expenses, a 1.0% tax on insurance premiums will be sufficient only if physicians' incomes are taxed at 5% and either

   a. health insurance premiums grow faster than 8%, or

   b. funds to start the program can be borrowed at less than 9%, or

   c. an additional 2.5% tax is levied on physicians' incomes (bringing the total physician income tax to 7.5%).

3. If students borrow only $3,000 per year for living expenses, 1% tax on health insurance premiums produces an enormous surplus at any reasonable level of interest on funds to start the program, assuming only 8% growth of premiums and only 5% physician income tax.

These preliminary analyses are not in any sense meant to serve as the basis for a proposed system to fund medical education. In the first place, we have explored but two funding mechanisms, and there must be a variety of others which should be considered. Secondly, our analysis itself has been superficial, and the assumptions on which it was based were tentative, though sensible. (It is not clear that, when estimating 40 years ahead, more sophisticated assumptions would be any more accurate.)

What these analyses do show is that, at the boundaries of a program to fund medical education, the system seems economically possible with reasonable measures of taxation. We hope that those more directly involved with medical education will conduct extensive studies to develop a sound funding mechanism, which certainly seems possible and which surely is needed.

TABLE 1

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.06	0	0.07	20	0.05

Insurance tax = 0.
Cost of year's education = $7,500 increasing 7% annually.
Number of students entering = 5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	0	161	161
5	268.2	0	0	1,491	350
10	450.0	20.3	0	4,130	660
15	734.6	129.4	0	8,659	1,096
20	1,175.4	314.0	0	16,062	1,777
25	1,852.1	617.5	0	27,934	2,833
30	2,883.1	1,085.1	0	46,726	4,477
35	4,444.1	1,747.8	0	76,474	7,082
40	6,794.7	2,768.3	0	123,235	11,095

Repayment schedule for student entering in year 0:
Original amount borrowed = $33,300;
Equal annual payments from year 11 through year 30 = $3,100.

TABLE 2

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.06	0.05	0.07	20	0.05

Insurance tax=0.
Cost of year's eduction=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	0	161	161
5	268.2	0	0	1,491	350
10	450.0	31.9	0	4,111	648
15	734.6	196.6	0	8,401	1,018
20	1,175.4	475.5	0	15,053	1,568
25	1,852.1	933.6	0	25,205	2,381
30	2,883.1	1,638.5	0	40,556	3,606
35	4,444.1	2,639.2	0	64,068	5,539
40	6,794.7	4,180.0	0	100,019	8,449

Repayment schedule for student entering in year 0:
Original amount borrowed=$33,300;
Equal annual payments from year 11 through year 30=$4,700.

TABLE 3

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.06	0.05	0.09	20	0.05

Insurance tax=0.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	158.8	0	0	161	161
5	208.2	0	0	1,491	350
10	450.0	37.1	0	4,102	643
15	734.6	228.2	0	8,281	981
20	1,175.4	551.8	0	14,581	1,469
25	1,852.1	1,083.5	0	23,920	2,166
30	2,883.1	1,901.5	0	37,640	3,193
35	4,444.1	3,062.8	0	58,193	4,807
40	6,794.7	4,851.0	0	89,013	7,193

Repayment schedule for student entering in year 0:
Original amount borrowed=$33,300;
Equal annual payments from year 11 through year 30=$5,500.

TABLE 4

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.06	0	0	0	0.05

Insurance tax=0.
Physicians' tax=Number of particlpating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	0	161	161
5	268.2	0	0	1,491	350
10	450.0	44.3	0	4,077	635
15	734.6	186.2	0	8,367	1,026
20	1,175.4	471.6	0	15,066	1,572
25	1,852.1	1,007.5	0	25,039	2,301
30	2,883.1	1,969.7	0	39,225	3,218
35	4,444.1	3,643.4	0	58,446	4,273
40	6,794.7	6,148.9	0	83,639	5,664

TABLE 5

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=0.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	0	161	161
5	268.7	0	0	1,593	390
10	450.0	44.3	0	4,652	777
15	734.6	186.2	0	10,239	1,382
20	1,175.4	471.6	0	19,849	2,339
25	1,852.1	1,007.5	0	35,707	3,808
30	2,883.1	1,969.7	0	61,002	6,007
35	4,444.1	3,643.4	0	100,184	9,211
40	6,794.7	6,148.9	0	159,904	14,107

TABLE 6

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0.05	0.07	20	0.05

Insurance tax=½%×$30 billion increasing 8% annually.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	220	232	72
10	450.0	31.9	324	891	167
15	734.6	196.6	476	1,869	215
20	1,175.4	475.5	699	3,074	257
25	1,852.1	933.6	1,027	4,427	274
30	2,883.1	1,638.5	1,509	5,755	264
35	4,444.1	2,639.2	2,218	7,164	290
40	6,794.7	4,180.0	3,259	8,602	278

Repayment schedule for student entering in year zero:
Original amount borrowed=$33,300;
Equal annual payments from year 11 through year 30=$4,700.

TABLE 7

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0	0.05	20	0.05

Insurance tax=½%×$30 billion increasing 10% annually.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	242	170	49
10	450.0	17.3	389	576	99
15	734.6	110.0	627	1,099	104
20	1,175.4	267.0	1,009	1,518	60
25	1,852.1	524.9	1,625	1,405	−100
30	2,883.1	922.4	2,617	−165	−502
35	4,444.1	1,485.8	4,215	−4,401	−1,133
40	6,794.7	2,353.3	6,789	−13,381	−2,339

Repayment schedule for student entering in year 0:
Original amount borrowed=$33,300;
Equal annual payments from year 11 through year 30=$2,700.

TABLE 8

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.08	0	.05	20	.05

Insurance tax= ½%×$30 billion increasing 10% annually.
Cost of year's education= $7,500 increasing 7% annually.
Number of students entering = 5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	242	173	50
10	450.0	17.3	389	598	106
15	734.6	110.0	627	1,177	119
20	1,175.4	267.0	1,009	1,707	88
25	1,852.1	524.9	1,625	1,773	−59
30	2,883.1	922.4	2,617	448	−441
35	4,444.1	1,485.8	4,215	−3,738	−1,139
40	6,794.7	2,353.3	6,789	−12,972	−2,430

Repayment schedule for student entering in year 0:
Original amount borrowed= $33,300;
Equal annual payments from year 11 through year 30= $2,700.

TABLE 9

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	.05	20	.05

Insurance tax=½%×$30 billion increasing 10% annually.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Repayment	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	242	177	51
10	450.0	17.3	389	622	112
15	734.6	110.0	627	1,261	136
20	1,175.4	267.0	1,009	1,920	120
25	1,852.1	524.9	1,625	2,207	−6
30	2,883.1	922.4	2,617	1,203	−371
35	4,444.1	1,485.8	4,215	−2,731	−1,116
40	6,794.7	2,353.3	6,789	−12,058	−2,486

Repayment schedule for student entering in year 0:
Original amount borrowed=$33,300;
Equal annual payments from year 11 through year 30=$2,700.

TABLE 10

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0	0	0	0.05

Insurance tax=½%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×4%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	220	232	72
10	450.0	35.4	324	874	163
15	734.6	149.0	476	1,991	267
20	1,175.4	377.3	699	3,690	389
25	1,852.1	806.0	1,027	5,969	495
30	2,883.1	1,575.7	1,509	8,535	504
35	4,444.1	2,914.7	2,218	10,444	248
40	6,794.7	4,919.1	3,259	9,979	−322

TABLE 11

Interest rates			Payback period	Loan service rate
Debt	Graco	Payback		
0.07	0	0	0	0.05

Insurance tax=½%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	220	232	72
10	450.0	44.3	324	856	154
15	734.6	186.2	476	1,833	222
20	1,175.4	471.6	699	3,082	261
25	1,852.1	1,007.5	1,027	4,252	194
30	2,883.1	1,969.7	1,509	4,386	−135
35	4,444.1	3,643.4	2,218	1,341	−1,029
40	6,794.7	6,148.9	3,259	−8,127	−2,444

TABLE 12

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.08	0	0	0	0.05

Insurance tax=½%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	220	236	74
10	450.0	44.3	324	888	162
15	734.6	186.2	476	1,948	245
20	1,175.4	471.6	699	3,386	310
25	1,852.1	1,007.5	1,027	4,907	280
30	2,883.1	1,969.7	1,509	5,608	−3
35	4,444.1	3,643.4	2,218	3,350	−858
40	6,794.7	6,148.9	3,259	−5,585	−2,401

TABLE 13

Interest rates			Payback period	Loan service rate
Debt	Graco	Payback		
0.09	0	0	0	0.05

Insurance tax=½%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	150	11	11
5	268.2	0	220	240	76
10	450.0	44.3	324	920	172
15	734.6	186.2	476	2,073	271
20	1,175.4	471.6	699	3,725	366
25	1,852.1	1,007.5	1,027	5,665	385
30	2,883.1	1,969.7	1,509	7,090	171
35	4,444.1	3,643.4	2,218	5,938	−606
40	6,794.7	6,148.9	3,259	−1,724	−2,247

TABLE 14

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=0.
Cost of year's education=$7,500 increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	153.8	0	300	−139	−139
5	268.2	0	441	−1,010	−200
10	450.0	0	648	−2,223	−273
15	734.6	0	952	−3,828	−354
20	1,175.4	0	1,396	−5,843	−435
25	1,852.1	0	2,055	−8,212	−496
30	2,883.1	0	3,019	−10,744	−504
35	4,444.1	0	4,436	−13,012	−400
40	6,794.7	0	6,517	−14,184	−88

TABLE 15

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=0.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	441	162	74
10	810.0	0	648	1,070	274
15	1,322.3	0	952	3,592	697
20	2,115.7	0	1,398	9,355	1,528
25	3,333.8	0	2,055	21,285	3,084
30	5,189.7	0	3,019	44,516	5,905
35	7,999.4	0	4,436	87,897	10,894
40	12,230.4	0	6,517	166,456	19,546

TABLE 16

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	441	162	74
10	810.0	44.3	648	982	227
15	1,322.3	186.2	952	2,763	458
20	2,115.7	471.6	1,398	6,092	826
25	3,333.8	1,007.5	2,055	11,788	1,376
30	5,189.7	1,969.7	3,019	20,888	2,147
35	7,999.4	3,643.4	4,436	34,536	3,146
40	12,230.4	6,148.9	6,517	54,328	4,647

TABLE 17

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 9% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	462	100	50
10	810.0	44.3	710	634	140
15	1,322.3	186.2	1,093	1,611	233
20	2,115.7	471.6	1,681	3,036	314
25	3,333.8	1,007.5	2,587	4,615	295
30	5,189.7	1,969.7	3,980	5,326	−20
35	7,999.4	3,643.4	6,124	2,564	−1,043
40	12,230.4	6,148.9	9,423	−8,467	−3,003

TABLE 18

Interest rates			Payback perlod	Loan serviee rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 9% annually.
Physicians' tax=Number of participating MD's×7.5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	462	100	50
10	810.0	66.4	710	590	116
15	1,322.3	279.4	1,093	1,197	114
20	2,115.7	707.4	1,681	1,404	−37
25	3,333.8	1,511.2	2,587	−150	−576
30	5,189.7	2,954.5	3,980	−6,070	−1,704
35	7,999.4	5,465.1	6,124	−20,944	−4,035
40	12,230.4	9,223.3	9,423	−52,559	−8,031

TABLE 19

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	441	160	72
10	810.0	44.3	648	932	209
15	1,322.3	186.2	952	2,514	399
20	2,115.7	471.6	1,398	5,299	675
25	3,333.8	1,007.5	2,055	9,756	1,048
30	5,189.7	1,969.7	3,019	16,327	1,499
35	7,999.4	3,643.4	4,436	25,196	1,948
40	12,230.4	6,148.9	6,517	36,479	2,551

TABLE 20

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×7.5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years after.
Cost of year's education=$7,500 educational and $6,000 living expense, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	276.8	0	300	−9	−9
5	482.8	0	441	160	72
10	810.0	66.4	648	888	186
15	1,322.3	279.4	952	2,117	286
20	2,115.7	707.4	1,398	3,781	356
25	3,333.8	1,511.2	2,055	5,464	296
30	5,189.7	2,954.5	3,019	5,953	−100
35	7,999.4	5,465.1	4,436	2,439	−1,243
40	12,230.4	9,223.3	6,517	−9,487	−3,091

TABLE 21

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.07	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years later.
Cost of year's education=$7,500 educational and $3,000 living expenses, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	215.3	0	300	−74	−74
5	375.5	0	441	−403	−57
10	630.0	44.3	648	−629	−48
15	1,028.4	186.2	952	−961	−84
20	1,645.6	471.6	1,398	−1,651	−186
25	2,593.0	1,007.5	2,055	−3,218	−423
30	4,036.4	1,969.7	3,019	−6,694	−923
35	6,221.8	3,643.4	4,436	−14,012	−1,909
40	9,512.5	6,148.9	6,517	−28,019	−3,416

TABLE 22

Interest rates			Payback period	Loan service rate
Debt	Grace	Payback		
0.09	0	0	0	0.05

Insurance tax=1%×$30 billion increasing 8% annually.
Physicians' tax=Number of participating MD's×5%×$30,000 increasing 7% annually.
Physician tax starts 10 years after entering med school, ends 40 years later.
Cost of year's education=$7,500 educational and $3,000 living expenses, both increasing 7% annually.
Number of students entering=5,500+250 annually.

[*All figures in millions of dollars*]

Year	New loans	Physician tax	Insurance tax	Outstanding debt	Yearly increase in debt
0	215.3	0	300	−74	−74
5	375.5	0	441	−426	−65
10	630.0	44.3	648	−712	−63
15	1,028.4	186.2	952	−1,149	−110
20	1,645.6	471.6	1,398	−2,021	−232
25	2,593.0	1,007.5	2,055	−3,928	−510
30	4,036.4	1,969.7	3,019	−8,079	−1,099
35	6,221.8	3,643.4	4,436	−16,783	−2,272
40	9,512.5	6,148.9	6,517	−33,628	−4,152

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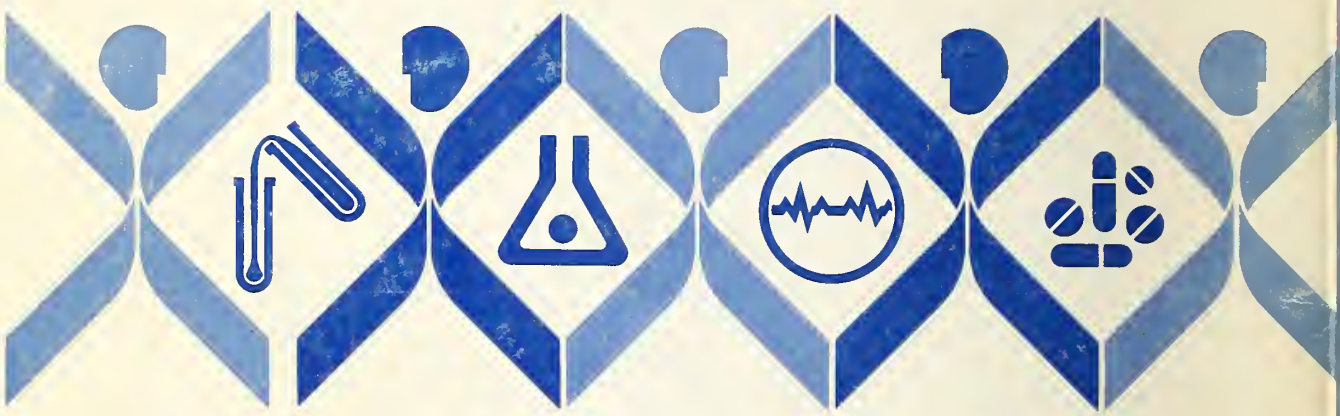
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